The Iquique Railroad, Southern Peru.*

BY HENRY SADLEIR RIDINGS, M.A., M. INST. C. E.

The elevated plain of the province of Tarapaca is connected by rail with three ports on the Pacific Ocean, namely, Iquique, Pisagua, and Patillos. The present Paper refers chiefly to the Iquique Railway, in latitude 20° 13′ S.; longitude, 70° 13′ W. The object of the railways was to develop the nitrate of soda trade, and much has been effected towards this end. Between 1870 and 1879 the quantity of nitrate annually exported, from all the ports of the province, was 5,000,000 quintals, or 227,272 tons, whereas the present quantity is about 340,909 tons annually, of which nearly 320,000 tons pass over the railways.

The abruptness of the mountains facing the sea, and their rugged and broken character, entailed considerable difficulty in finding the best line, and many trial sections had to be taken. On the Pisagua line it was necessary to put in no less than three reversing sidings, but at Iquique one was sufficient. This was protected by a safe y siding, running up at gradients gradually increasing to a maximum of 7 in 100. The cuttings were mostly in hard metamorphic rocks, and the difficulties of construction were much increased from the barrenness of the soil and the absence of potable water. Provisions and water, distilled from sea-water, had to be carried by mules over the mountains.

The Iquique Railway, including branches and sidings to factories, is 93 miles long. To a point 3,067 feet above sea-level, and distant from the port 19 miles, there is a continuous rise, the average gradient being 3.06 per 100, and the maximum 4 per 100. After this point there are alternating lengths of level, and rising and falling gradients, the former being 3 per 100, and the latter 1.7, 2.16, and 3 per 100; so that leaving the nitrate grounds for the port, the last named gradients are against the heavy traffic. The curves from the port, to the height of 3,067 feet, are numerous, and range from 1,000 feet radius to a minimum of 350 feet. The permanent way, 4 feet 8½ inches gauge, is laid with steel rails of the Vignoles type, of 64 lbs. to the lineal yard, and tie-rods are freely adopted on the curves.

Three classes of locomotives are in use; those of Sharp, Stewart & Co.; Rogers (American); and the Fairlie. The mileage of the different classes for the summer, October, 1881 to March 1882 inclusive, was: Rogers, 11,616; Sharp, Stewart & Co., 25,269; and Fairlie, 57,517; which, with 4,439 run, for a short time, by another type of locomotive, brings the total for six months to 98,841 miles.

The wagons are platforms, with eight wheels on two bogie-frames, and with a brake acting on each wheel. Some of the wheels are of chilled cast-iron; the others are radial, with steel tires. Although the life of the former in the United States is upwards of 100,000 miles, their use on a mountain railway like this, where skidding cannot always be avoided, produces great wear and tear, through the flat places that are created in the tread, which it is impossible to turn up.

Two classes of passenger coach are employed; the American, on two bogie frames, on four wheels each, and the Grover. Both pass the curves with ease and safety.

In the period under review, the paying weight moved over the railway was as follows:

		From the Port.	To the Port.
1881.—	October	4,957 tons.	14,942 tons.
	November	5,020 ,,	18,224 ,,
	December	5,161 ,,	20,363 ,,
1882.—	January	5,478 ,,	20,576 ,,
	February	5,940 ,,	17,119 ,,
	March	6,013 ,,	19,577 ,,
	Total	32,569 ,,	110,801 ,,

This weight is exclusive of small traffic, materials for extensions, stores, etc. The dead weight required for the removal of the traffic from the port consisted of two thousand four hundred and twenty-eight wagons, each weighing 7 tons, and the number of vehicles which left the port empty was six thousand and forty. Therefore the total weight hauled against an average gradient of 3.06 per cent., for a distance of 19 miles, has been:

	Tons.
Paying load	32,569
Wagons which contained paying load	16,966
6,040 empty vehicles	42,280
Total	91,815

A loaded wagon weighs 20 tons, of which 7 tons constitute the non-paying weight. At times some of the wagons to the port have been loaded with 15 tons, which the author considers excessive; also some of the first type of platform wagons tared over 7 tons. This undue proportion of dead to paying load will be remedied on the introduction of new rolling stock; for, admirable as the double bogie car is for passing sharp curves, a lighter vehicle is far more suitable to a road on which there are such steep gradients as on this. In the movement of the total paying load, or 143,370 tons, the number of vehicles employed was two hundred and twenty-four. The mileage by loaded vehicles during the six months was in the proportion of 2.166 to 1, or 439,627 miles loaded to 202,947 empty.

During the period referred to, 8,484,536 gallons of water were consumed by the locomotives, or 1,414,089 gallons per month, which at the price of 1½ cent., at the exchange of 35*d.* is £3,093 6*s.* 4*d.* On the mileage of 98,841 the running has consequently been 11.65 miles per 1,000 gallons of water consumed.

Three classes of water are used; that which is brought in steamboats from the wells of Arica, 100 miles north of Iquique; that which is found in the wells on the plains, about 45 miles from the port, and conveyed over some parts of the system in tanks, and by pipes over others; and distilled sea-water. The water from Arica is used in its natural state; that from the plains of Tarapaca is prepared, before using it in the locomotive boilers, by precipitating the magnesia and lime in solution by carbonate of soda and quicklime. The Arica water is the best suited to the boilers.

The following is an analysis, in grams, of impurities to a litre of water:—

—	From Wells on the plains natural state.	From Wells on the plains prepared by precipitation.	From Arica.
	Gram.	Gram.	Gram.
Common salt	1.5790	1.9568	0.2447
Chloride of magnesia	0.1737	...	....
Sulphate of soda	0.0735	1.5847	0.1397
Sulphate of lime	0.9843	....	0.1931
Carbonate of lime	0.2499	. 8	0.1100
Carbonate of magnesia	0.0323	0.0306	0.0080
Silica	0.0200	0.0180	0.0300
	3.1136	3.6701	0.7255

The quality of the water is not the only difficulty to be contended with, as, in consequence of the want of a line of pipes connecting the wells of the plains with the stations, it has been necessary to convey the water in tanks to several points where the locomotives stop, and to make use, therefore, of the steam power in the haulage of tanks, instead of a more paying load. For some years, too, it was necessary to propel the tanks in ascending the gradient, in order to receive their water into the tanks of the locomotives through a pipe which connected them with the latter.

The unsettled state of the country has hitherto militated much against the improvement of the property. Another element which greatly increases the cost of working is the dense fog, especially during winter, which produces the slippery rail so common in mountainous districts. At this season the tires of the locomotives suffer very much, their average life being 32,000 miles.

The mileage of the locomotives during the period referred to has been 98,841; the coal consumed at the rate of 1 ton for each 29 miles; and the cost of maintenance of the permanent way has been, for wages and materials, $68,307.66, or $734.49 per mile. The cost of maintenance per mile run has been $0.69, at 35*d.* exchange, and $0.47 for each ton carried. The average distance travelled by 1 ton is 38 miles, and the cost of maintenance per ton per mile has been 1¼ cent. The total working expenses during the six months referred to were 45.399 per cent. of the gross receipts.

On no part of the system is the speed allowed to exceed 15 miles an hour, and in the descent of the steep gradients it is reduced to 8 miles. The movement of the trains is conducted on the permissive-block system, and, since the line has been under English management, immunity from accident has placed it on a very favorable footing as compared with other railways.

Some of the special features of the railways of Southern Peru, and the peculiar difficulties encountered in the construction and working of them, are the following. The great height to be attained, between 3,000 and 4,000 feet above sea-level, within practically narrow limits of distance, necessitated very steep gradients, commencing at the ports of Iquique and Pisagua, as the mountains rise abruptly from the sea. The extremely rugged and broken character of the country for a considerable distance after the coast-range is surmounted necessitated many trial surveys and rectifications before the line was finally decided upon, and made the use of very sharp curves obligatory to avoid enormous expense. On this section also the cuttings were all either in solid rock, or in the baked crust, which was so hard that powder had to be used. The entire absence of potable water and of food products was a serious difficulty, and a source of great expense during construction, all the water used at that time being distilled, and the food brought in steamers from more favored parts. As shown above, the water difficulty has been partially overcome, and by the expenditure of more capital, a first-rate supply may be obtained from the second range of mountains to the east of Iquique. Severe earthquakes, followed nearly always by inrushings of the sea, have been a serious difficulty and a source of expense. That of May 9, 1877, occurring as it did at night, and without warning, involved a direct outlay (for materials and wages) of $17,000 on the Iquique section, and a rather smaller, but still considerable expense, on the Pisaqua section; and the loss from suspension of traffic during repairs was of course much more serious. On that occasion the town line, used for taking the nitrate of soda to the various stores and wharves along the sea-shore, was destroyed, and in some places completely obliterated; the railway pier also was washed away, and the water-condensers were much injured. Up the mountain the rails were in many places twisted in a most extraordinary manner; embankments were shaken down, leaving the rails suspended in the air, and rocks were thrown into the cuttings. Large gangs of men were set to work, and in a comparatively short time repaired the damage.

Serious conflagrations have twice destroyed the most important business portion of the town of Iquique, disturbing the railway traffic for a short time, though this loss has been more than made up for shortly afterward by the increased demand for nitrate from the interior to supply the place of that burned.

The railways seem now to have entered upon a period of prosperity; but for some years previously the war between Chili and Peru was a cause of great loss, both from destruction of property by bombardments, etc., and from the injury to the traffic, sometimes from blockading the ports, and at other times from the forced use of the lines for carriage of troops and war material, and the compulsory lowering of rates. For a considerable period the erecting and repairing shops were completely dismantled, and the pieces of the machinery, etc., buried.

*From other selected papers of the Institution of Civil Engineers.

SIZES OF CHIMNEYS FOR STEAM BOILERS.

Formula, H.P. $= 3.33\ (A - 0.6\sqrt{A})\sqrt{h}$.

Diameter, inches.	Area A, Square feet.	Effective Area $E = A - 0.6\sqrt{A}$, Sq. Feet.	HEIGHT OF CHIMNEY. 80 ft.	60 ft.	70 ft.	80 ft.	90 ft.	100 ft.	110 ft.	125 ft.	150 ft.	175 ft.	200 ft.	Equivalent Sq. Chimney. Side of square $\sqrt{E} + 4$ inches.
			COMMERCIAL HORSE-POWER OF BOILERS.											
18	1.77	.97	23	25	27	....	....	....	.....	.....	.....	.....	.....	16
21	2.41	1.47	35	38	41	....	....	....	.....	.....	.....	.....	.....	19
24	3.14	2.08	49	54	58	62	....	....	.....	.....	.....	.....	.....	22
27	3.98	2.78	65	72	78	83	....	....	.....	.....	.....	.....	.....	24
30	4.91	3.58	84	92	100	107	113	....	.....	.....	.....	.....	.....	27
33	5.94	4.48	....	115	125	133	141	....	.....	.....	.....	.....	.....	30
36	7.07	5.47	....	141	152	163	173	182	.....	.....	.....	.....	.....	32
39	8.30	6.57	....	....	183	196	208	219	.....	.....	.....	.....	.....	35
42	9.62	7.76	....	....	216	231	245	258	271	.....	.....	.....	.....	38
48	12.57	10.44	....	....	....	311	330	348	365	389	.....	.....	.....	43
54	15.90	13.51	....	....	....	....	427	449	472	503	551	.....	.....	48
60	19.64	16.98	....	....	....	....	536	565	593	632	692	748	.....	54
66	23.76	20.83	....	....	....	....	....	694	728	776	849	918	981	59
72	28.27	25.08	....	....	....	....	....	835	876	934	1023	1105	1181	64
78	33.18	29.73	....	....	....	....	....	....	1038	1107	1212	1310	1400	70
84	38.48	34.76	....	....	....	....	....	....	1214	1294	1418	1531	1637	75
90	44.18	40.19	....	....	....	....	....	....	.....	1496	1639	1770	1893	80
96	50.27	46.01	....	....	....	....	....	....	.....	.....	1876	2627	2167	86

Table of Sizes of Chimneys.*

BY WILLIAM KENT, OF NEW YORK.

The accompanying table of sizes of chimneys for various horse-powers of boilers is based on the following data:

1. The draft power of the chimney varies as the square root of the height.

2. The retarding of the ascending gases by friction may be considered as equivalent to a diminution of the area of the chimney, or to a lining of the chimney by a layer of gas which has no velocity. The thickness of this lining is assumed to be two inches for all chimneys, or the diminution of area equal to the perimeter × two inches (neglecting the overlapping of the corners of the lining). Expressed algebraically, let D = diameter, A = area, E = effective area.

For square chimneys. $E = D^2 - \frac{8D}{12} = A - \frac{2\sqrt{A}}{3}$

For round chimneys, $E = \pi\left(D^2 - \frac{8D}{12}\right) = A - 0.592\sqrt{A}$

For simplifying calculations, the co-efficient of $\sqrt{A}$ may be taken as 0.6 for both square and round chimneys. and the formula becomes

$$E = A - 0.6\sqrt{A}.$$

3. The power varies directly as this effective area E.

4. A chimney 80 feet high, 42″ diameter, has been found to be sufficient to cause a rate of combustion of 120 pounds of coal per hour per square foot of area of chimney, or, if the grate area is to the chimney area as 8 to 1, a combustion of 15 pounds of coal per square foot of grate per hour. This is fair practice for a boiler of modern type, in which flues, or tubes, are of moderate diameter, gas passages circuitous, and heating surface extensive in proportion to rate of combustion, so as to cool the chimney gases to 400° or 500°, and produce high economy.

5. A chimney should be proportioned so as to be capable of giving sufficient draft to cause the boiler to develop much more than its rated power, in case of emergencies, or to cause the combustion of 5 pound of fuel per rated horse-power of boiler per hour.

Conditions 4 and 5 being assumed, the 80′×42″ chimney, 9.62 square feet area, will cause the combustion of 9.62×120 = 1154.4 pounds of coal per hour, or at 5 pounds of coal per horse-power per hour is rightly proportioned for 231 horse-power of boilers.

The power of the chimney varying directly as the effective area, E, and as the square root of the height, h, the formula for horse-power of boiler for a given size of chimney will take the form.

H.P. $= CE\sqrt{h}$, in which C is a constant.

For the 80′×42″ chimney,

$E = A - 0.6\sqrt{A} = 7.76$ square feet.

$\sqrt{h} = 8.944$ square feet.

Substituting these values in the formula it becomes:

$$231 = C \times 7.76 \times 8.944,$$

whence $C = 3.33$,

and the formula for horse-power is

H.P. $= 3.33\ E\sqrt{h}$, or, H.P. $= 3.33\ (A - .6\sqrt{A})\sqrt{h}$.

If the horse-power of boiler is given, to find the size of chimney, the height being assumed.

$$E = \frac{0.3 \text{ H.P.}}{\sqrt{h}}$$

For round chimneys, diameter of chimney = diameter of $E + 4''$.

For square chimneys, side of chimney = $\sqrt{E} + 4''$.

In the formulas and table no account has been taken of the difference which is believed by some authorities to exist in the efficiencies of round and square chimneys of equal area, nor of the differences of friction and of rate of cooling of the gases in iron and in brick chimneys. Should experimental data of these differences, or of the effect of infiltration of air into brick chimneys, be obtained in future, the formulas and table may be corrected accordingly.

*A Paper read before the "AMERICAN SOCIETY OF MECHANICAL ENGINEERS."

Artesian Well at Bourn, Lincolnshire.*

BY JAMES PILBROW, M. INST. C. E.

The subject of artesian wells is not without interest to the engineer, whose attention is chiefly directed to the supply of towns and other places with water. For this reason, the description of a small but productive artesian-well, completed at Bourn in Lincolnshire in 1856, is presented. The well was intended to supply the town of Bourn with water. the undertaking being in the hands of a small joint-stock company. The town had been until then, without any public supply, and almost without a private one. The wells were shallow, as in most of the towns in that part of the county; but many houses were wholly dependent upon carts, which fetched water from a considerable distance. These circumstances gave increased importance to the fact of such a supply being found under the site of the place.

The boring, 4 inches in diameter, passed through several oolitic strata, to a depth of 92 feet. Below the alluvial soil and gravel, a hard shelly limestone, 32 feet in thickness, was encountered. The bore-hole here was made slightly conical to admit of the taper end of a cast-iron pipe being inserted and driven tightly, to exclude any surface-water, and to prevent water from the bore escaping into the gravel, and thus lose its full power to rise above the surface. The boring was then continued, through various beds, til it reached a stratum, 6 feet thick, of compact and hard rock, in passing through which, at 92 feet below the surface, the tool fell suddenly about 2 feet, evidently into a chasm or hollow, striking upon the hard surface of the underlying rock. The water immediately rushed up with great force, and drove the men from their work; and it was not without difficulty that the joints for attaching the curved pipe and sluice-valve at the surface could be accomplished.

The site of the town of Bourn partakes of the ordinary character of the county, and is flat; the highest part, where the well is situated, being only about 6 feet above the general level. It had been the intention of the author, should the water rise with sufficient force, as he believed it would do, to supply the town direct from the boring, and in this way the work was carried out, the flow and pressure having proved even greater than was anticipated.

An air-chamber was fixed at the well to regulate the pressure, and to equalize the supply of water to the town. The water rose at the Town Hall exactly 39 feet 9 inches above the ground. The yield at the bore and surface-level, ascertained by filling a tank capable of containing 5,000 gallons, was at the rate of 567,000 gallons per day, and there was no diminution on letting the whole run continuously to waste. The yield was also tested by a "notch-board," which, by using the coefficient 0.563, and measuring at still-water and not at the "crest," gave 575,201.8 gallons

The author knows of no other boring of like dimensions, either in this country or on the Continent, which yields so large a quantity of water, or where, the boring being made on the general level of the surrounding district, the water from which flows to so great a height above the ground.

It is needless to say that the town of Bourn has since enjoyed an unlimited supply of pure water without the assistance of engine, pumps, or reservoirs, and in far greater quantity than it requires. The town of Spalding, several miles distant, has subsequently been supplied from the same source, the water being conveyed by pipes laid under the turnpike road. The water-mains were laid under every street, with fire-cocks at intervals, and it was satisfactory to all, and surprising to some, to see the water thrown upon the roofs of houses by a hose and jet-pipe, as from a fire-engine, and that only by the natural pressure of the spring.

The water, by Professor Brand's test gave 19.4 degrees of hardness. arising chiefly from the presence of bi-carbonate of lime; but by boiling it is rendered much softer.

*From other selected papers of the Institution of Civil Engineers.

THE receipts from tolls for the month of November on the Brooklyn Bridge, as shown by the Treasurer's statement, were: On Promenade, from New York $1,505, from Brooklyn $1,339. Total $2,844; on Railroad, from New York $17,765, from Brooklyn $22,117. Total $39,882. On Carriageway from New York $2,679, from Brooklyn $2,687. Total $5,366. Total receipts from tolls for the month $48,092.

The average daily receipts were: from Promenade $94.80, from Railroad $1,329.40, from Carriageway $178.87. Total daily average for November $1,603.07.

The total receipts from tolls for the first six months of the second year of operation of the bridge were: on Promenade from New York $10,707, from Brooklyn $9,310. Total $20,017; on Railroad from New York $95,700, from Brooklyn $118,700. Total $214,400; on Carriageway from New York, $17,225, from Brooklyn, $18,156. Total $35,411. Total receipts from tolls for six months $269,828.00.

Underground Telegraph-Wires.

AT the three hundred and thirty-second meeting of the Society of Arts, held November 13, W. W. Jacques, electrician of the American Bell Telephone Company, read a paper on "Underground Telegraph Wires."

The first telegraph line constructed in this country, from Baltimore to Washington, in 1843, was intended to be laid underground, and the first nine miles were so laid. Four copper wires were each wound with cotton soaked in shellac, and the whole drawn into a lead tube. This tube was laid in a trench by the side of the railroad. Hardly was the section completed, however, when water found its way into the joints, destroying the insulation, and the conductors failed. They were accordingly replaced by wires strung on poles, and the rest of the line was constructed in this way. In England a similar line was built for a distance of thirteen miles along the Great Western Railway, which failed in exactly the same way as the American line, and was soon replaced by a pole line. The same thing occurred at various places on the Continent, and thus although the first idea of telegraph engineers was to have underground lines, they were obliged to resort to pole lines. In Europe there has always been a strong desire to have a part of the electric wires under ground, on account of their safety, secrecy and reliability. After the introduction of gutta-percha, in 1846, many systems were tried, and the result is that there now exists a successful and durable system of underground telegraph-wires connecting the principal cities of Germany and France. In many European cities the lines are carried under ground as far as the outskirts, and in Paris not only all the telegraph lines, but also those for electric lights, telephones and other purposes, are carried through the sewers.

These systems, however, have cost from ten to twenty times as much as similar overhead lines, and there are many more miles of the latter than of underground lines; while in Paris, which is the only city in the world having a complete underground system, the great size of the sewers affords unusual facilities for running wires. Moreover, it has been found that, for delicate and quick-working apparatus, such as automatic telegraphs, polarized relays, and especially the telephone, long underground lines are far less efficient than pole lines. Apart from the difficulty of securing good insulation, there are two reasons for for this fact; viz., (1) the *retardation* which takes place when the conductor is brought near the earth, which limits the speed of working the apparatus, or, in the case of the telephone, confuses and destroys the signals altogether; and (2) *induction*, which is noticed when two or more wires are run close together, as they must be when under ground, and which causes a message sent over one wire to be received on all the others. With telephone-wires this is noticeable on wires as short as one thousand feet. Steady currents, like those for electric lights, are, of course, unaffected by either of these phenomena.

The history of the attempts which have been made in the direction of underground wires proves that for long lines between cities, in this country, pole lines, which can be easily built and repaired, and where the wires are not subject to the effects of retardation or induction, are decidedly superior to underground lines. Between 1847 and 1870, all the systems which had been tried had proved complete failures. Since that time, however, in England, Germany and France, several lines have been built that have continued to work successfully. The English system used until recently between Liverpool and Manchester, was constructed by laying iron or stoneware pipes from one to two feet below the ground, and drawing in the cable of gutta-percha covered wires. The route was selected through a marshy section of country, so that the pipe was almost constantly filled with water, so as to preserve the gutta-percha. In the present German system, which dates from 1875, the cable is composed of seven copper wires, each coated with two layers of gutta-percha and two of Chatterton's compound, and the whole covered with an armor of galvanized-iron wires; this is laid in a trench by the roadside. The cost of the system was nearly twenty times that of a well-built pole line. The present French system was begun in 1880, and consists of cables of gutta-percha covered wires, which are drawn into iron pipes three or four inches in diameter, and buried along the side of the road. Although all these systems are now in successful operation, they are far less efficient than pole lines of the same length would be. The speed of working is limited, and the use of the telephone over considerable distances is impossible.

The speaker then gave an account of some experiments he had made on copper wire, insulated with gutta-percha, laid under ground, with a metallic circuit instead of the usual ground return, and in all cases covered. These experiments had been made on the Paris telephone-wires, the French Government wires between Paris and Orleans, the line between Paris and Soissons, and several German lines. The distances talked over in miles varied from twenty to eighty-five miles. These experiments had led Dr. Jacques to the discovery of the emprical law that if the product of the total resistance in ohms by the total capacity in microfarads was less than about 18,000, perfectly good conversation was possible, while if it exceeded that number, talking was more difficult, and in many cases impossible.

Within our large cities the problem is somewhat different, however, from that of connecting two cities with each other. The number of wires has of late been rapidly increased, and if run on poles, they disfigure the streets, interfere with the operations of firemen, in case of fire, and cause annoyance to tenants and house-owners. These disadvantages have led many to ask whether the wires cannot be buried, at least in the cities.

In Paris, all wires are carried under ground in the sewers; in London, telegraph-wires are so carried from the central office to many of the branch offices; and in many German and Austrian cities the telegraph-wires are so carried to the outskirts; but in European cities, as in America, most of the telephone and electric-light wires, and a majority of the telegraph-wires also, are still carried on poles or over house-tops. In Paris, the telephone-wires are protected from induction and retardation by using, instead of a single wire, two wires twisted together, forming a metallic circuit, which obviates the difficulties referred to, though doubling the cost of the wire. It is thus *technically* possible to place all of the wires in a city under ground, but the cost is enormously increased, being five times as much as a pole line, even in Paris, where no separate piping or chambers to contain the wires are necessary. To put such a system as one of our telephone exchanges under ground would place the cost of the instruments entirely out of reach of the subscribers. While it thus seems impracticable to put all of the wires underground in cities, much may be done by putting the heavier lines, where a large number of lines run side by side for a considerable distance, under the streets. Our American telegraph and telephone companies have recognized this fact, and several underground lines have recently been constructed by them. The American Bell Telephone Company has two short lines of such wires in the business section of Boston, about a quarter of a mile long each. On account of the short distance, it was considered best to use single-line service, trusting that the induction and the retardation would not be serious. The system is constructed by laying eight wrought-iron pipes, three inches in diameter, side by side in two rows, about four feet below the surface. At each street-corner a brick chamber is built, large enough to admit a man, and with a cover flush with the street. The cables run out from the basement of the central office, through the pipes and up the side of buildings to the roof, from which they spread out to the subscribers by means of ordinary overhead lines.

The speaker then showed samples of the different kinds of cables that are in use, and referred briefly to the underground lines in use in Washington, Pittsburgh and Chicago.

At the conclusion of Dr. Jacques's paper, Professor Cross referred to the conditions necessary for the successful operation of underground wires; viz., high conductivity and larger section of the wire, a thick coating of a good insulating material, and low specific inductive capacity of this insulator.

Professor A. E. Dolbear said that what Dr. Jacques had said had shown that the use of any very considerable length of underground wire would be almost impossible, or at least impracticable. There was a great difference between telegraph and telephone wires, as regards the difficulties met with, and with the telephone there was no advantage gained in increasing the strength of the battery beyond a certain point; neither could such increase of strength do anything in the way of obviating the difficulties of retardation or induction. Only a weak current was necessary for telephonic purposes, and no increase above that was necessary to do the real work of transmitting the vibrations would be of any advantage. There was also a great difference, in telephonic work, in working at different ends of the line.

Professor Cross referred at some length to the effect of the electric capacity of the conductor and the deformation of the electric wave or impulse resulting thereform. The greater the capacity of the cables, the greater its effect in flattening the wave, thus tending to confuse rapid signals and rendering a slower rate of transmission necessary in telegraphy. When the telephone is used, as the rate of change of the electric pulses caused by the sound-waves cannot be altered, confusion and indistinctness result.

It is universally conceded now that large wires are the best, and they are now universally used in submarine cables, although at the time when the first Atlantic cable was proposed there were two parties among telegraph engineers, one advocating the use of large wires, and the other the use of small ones. A difficulty which has been experienced in telephone wires arises from the fact that strong pulses travel faster than weak ones. The speaker had made some experiments on this point with the experimental cable, five miles in length, laid near Attleborough by the American Bell Telephone Company. He had found that the sounds of short steel bars of very high pitch could be transmitted readily, even when their number of vibrations was far above the most rapid vibrations that ever occur in articulate speech, and through circuits in which the indistinctness due to electrical retardation was very decidedly manifested. From this he inferred that with intense sounds the change in the cable was abundantly rapid and sufficiently strong to effect the telephone receiver, even when the capacity was very great, and that the indistinctness probably arose in great part from overlapping of the electric pulses, caused by the stronger ones overtaking and fusing with the preceeding weaker pulses.

After some further discussion, the meeting was adjourned.

GEORGE F. SWAIN, *Secretary.*

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Good Bricks and Brick-Work.

There are certain criteria of good bricks, which, being infallible and readily applied, constitute the best practical tests as to the quality of these valuable materials. In the first place, good bricks are always heavy—always solid and compact, ringing with a clear, sharp sound, when struck together, and well and truly formed with nice sharp edges. Neither will they absorb much water. If you have to choose between two bricks of equal or nearly equal weight, immerse them in water after weighing them dry. Twenty-four hours after take them out, and reject the one which has acquired the most weight, and therefore imbibed most water. Over-burnt bricks may be heavy, but they are also cracked and distorted in form by undue heat, and may be readily distinguished from the better sort by their general appearance. Bad bricks on the contrary, are light, will not ring at all when struck together, are ill-shaped, hollow on one side and round on the other, readily abrade on the edges, and suck up water like a sponge, and indeed, are sometimes so soft that a strong thumb may force off the edges, such as they are.

Good brick-work is laid truly and accurately to a level; every joint answers truly to the line, and every part of the face coincides with the plumb. All the beds and joints are well filled with mortar until it is fairly pressed out in the faces; all deficiencies are carefully pointed up as the work proceeds, and the whole well flushed in course by course. The mortar is well mixed, lime and sand thoroughly blended, and the sand, if handled alone, is found to be clean and sharp to the touch, feeling thoroughly gritty, and free from all slimy, greasy, and tenacious qualities. The joints are never to exceed three-eighths of an inch, and should never exceed one-quarter of an inch in thickness, and the vertical lines must be truly plumb over each other in such courses as intended, according to the kind of bond employed. The work is also carried up uniformly level throughout and no difference permitted even for a temporary purpose, under any circumstances whatever. By these means only can unequal settlements be prevented. Contraction of bulk or settlement we know, must occur from the combination of materials in an expanded condition, as mortars and cements are, when in plastic form; and therefore all walls must sink or settle down as the mortar becomes dry; but it is essential, to prevent dislocation, that this settlement be uniform throughout, and this can only be secured by adopting the precautions prescribed above. For the same purpose the back and interior of the work must be brought up, laid, and finished as completely as the front, and no gaps or crevices left for subsequent patching. One other rule has to be observed, and we reserve it to the last, and separate, and emphatic statement, to show our estimate of its importance, in order to produce good brick-work, which is this—that the mortar should be as thick as it may be, or as nearly approaching the solid form as is consistent with the degree of plasticity essential for its proper distribution and penetrating into the joints, while the brick should be thoroughly wetted on the surface. By these means the adhesion between them is rendered the more perfect, and the subsequent amount of shrinking and settlement is reduced to a minimum. The watery mortar, on the contrary suffers extreme contraction, while the essential properties of the lime are actually dissipated, and when the wall becomes thoroughly dried, if it ever does, little remains in the way of cement but the sand compounded with it.—*The Northwestern Improvement Record.*

AT the Penna. State Department on Dec. 15h, a charter was granted to the Merchants and Manufacturers' Electric Light Company of Lancaster, with a capital stock of $20,000.

Building an Ice-House.

We can best answer numerous inquiries about building an ice-house by giving a description of one we put up for our own use a few years ago. The locality selected was one affording facilities for drainage, was well shaded by trees, and conveniently near the house. The surface being sandy, was levelled, and four by six-inch sills, fourteen feet long, were laid down and halved together at the corners. The plates of the same length, of two by four-inch stuff, were put together in the same manner. Studs two by four, and thirteen feet long, were morticed into the sills and spiked to the plates every eighteen inches. The roof, a "square-pitch," is covered with ten-inch boards of the same width nailed on as patterns. Hemlock boards, nailed horrizontally on both sides of the studs, cover the sides and ends; the four-inch space between the outer and inner siding, being filled with sawdust. There is a door at the ground level, and another just above, both being practically double, by means of horizontal boards placed on the inside as the house is filled. The roof projects over the sides about a foot, and the spaces between that and the plates are left open to afford ventilation. A layer of sawdust four inches or more thick, was laid upon the ground, and the blocks of ice stacked upon it as closely as possible. The top of the ice is covered with a layer of marsh hay, about two feet thick. This house, if filled up to the roof, would hold about sixty tons. When half filled, there has been a considerable quantity of ice left over each year, though it has been used very freely. The cost of the house is small.—*American Agriculturist.*

French Population Statistics.

Some interesting statistics have been compiled from the census returns of the population of Paris, taken in 1881. London in 1881 had a population of 3,816,483, but the total number of inhabitants of the French capital is 2,239,928, of whom 1,113,326, are of the male sex, and 1,126,602 female. According to the census returns of the year 1700, the earliest on record the Parisians numbered at that time 720,000. In 1876 they had risen to 1,988,806. Since then there has been an increase of 251,122 inhabitants. The present population occupies 68,126 dwelling houses, 32,422 of which are over four stories high. Paris counts 440,022 married men and 446,297 married women. The number of unmarried males is 621,569, as against 1,098,845 in London and there are only 557,054 spinsters of all ages, as against 1,192,253 in our capital. The youngest married man in Paris is 17 years old and the youngest married woman is 14 years old. Of widowers there are 51,735; three of them are 18 years old, and these are almost as many as in London, where there are 56,833; but the widows of London number 173,143, while in Paris there are only 123,251. It is noteworthy that only 348,845 male and 372,576 female Parisians were born in Paris the majority of the inhabitants of the city having come from the provinces, while 91,872 men and 75,542 women are foreigners. Of these there are 23,981 male and 21,300 female Belgians, 15,708 male and 5,874 female Italians, 15,441 male and 15,749 female Germans, 12,264 male and 8,546 female Swiss, 4,607 male and 6,182 female English, and 2,954 male and 2,973 female Americans, while 149 are miscellaneous Asiatics.

Teredo Boring.

At the International Forestry Exhibition in Edinburgh, Professor McIntosh recently delivered a very interesting lecture on "The Boring of Marine Animals in Timber." The lecturer stated, that, so far as we know at present, sponges only bored calcareous substances, while annelids never bored wood. The purple sea-urchin bores gneiss and granite by means of its teeth. The crustaceans and molluscs were the chief borers of wood. Of crabs, the *Cheluria terebrans* is even more destructive than the common Scotch crab or "gribble" (*Limnoria lignoram,*) which Robert Stevenson found so injurious to the Memel beams supporting his temporary beacon on the Bell Rock. The gribble attacks all kinds of timber, and the piles of the Trinity Chain Pier, at Leith, had formerly to be replaced every four years, owing to their ravages. It also bores into submarine cables, thus rendering them faulty. The xycophago, a small bivalve mollusc, is also very destructive of wood, entering it while young and growing to maturity inside. The teredo, or ship worm, is however, the most fatal wood-borer known and occurs in every ocean. It bores tunnels into the wood from one foot to a yard in length, and is still more wasteful to Dutch and French harbor works than to British. Two theories are advanced to explain the cutting of these creatures—one chemical, the other mechanical; but traces of acid solvents were only found in some calcareous borers, and they also occured in animals which did not bore. On the other hand, silicious cutters have been found on some borers, such as the teredo. With regard to preventives, the Dutch commissioners have recommended creosote for internal application to the wood, and metal sheathing for external. Professor McIntosh, while admitting the value of the Dutch investigation, pointed out that there was still much to be learned on the subject, and recommended it to the new marine laboratories now in progress. He also showed that the function of the borers was advantageous when it resulted in the destruction of sunken ships and waste timber floating on the sea.

Building Stone of Colorado.

A Committee of the Denver Society of Civil Engineers, and Prof. Regis Chauvenet, President of the State School of Mines, have made a report to the Board of Capital Managers, of the State of Colorado, on the building stone available for use in the proposed State Capitol.

The report gives the general charcteristics of the limestone, granite, sandstone and lava examined and also a table of tests made with a hydraulic press in the shops of the Denver & Rio Grande R. R. Co. From this table we give the following general results from about forty specimens tested: Granites: four specimens crushing strength per square inch, 11,938 lbs. to 19,110 lbs.; specific gravity, 2.65 to 2.71; weight per cubic foot 164,11 to 168.48 lbs. Limestones: four tests, crushing, 13,836 to 15.771 lbs.; specific gravity 2.75 to 287; weight, 165.36 to 179.09. Sandstones: twentv-nine specimens cruching, from 2,639 to 16,818 lbs.; specific gravity, 2.40 to 2.64; weight per cubic foot, 119.81 to 181.01 lbs. Lavas: five tests; crushing strength, 7,414 to 11,800 lbs.: specific gravity, 2.14 to 2.45; weight per cubic foot 109.20 to 141.65 lbs.

BERLIN STREET PAVING.—A new form of paving has been in use in Berlin since last year, which seems to offer some advantages over wood. Layers of bricks are put down, from four to six inches in length, and impregnated with asphalte. After a short period they lose any air and water that they may contain, and absorb from 15 to 20 per cent. of the bituminous matter, becoming remarkably elastic and capable of resisting pressure and damp. The traffic in the Berlin main thoroughfares is of a heavy character, and it has been found that the new paving lasts much longer than any of the other systems, added to which it offers a sure foothold to horses. Occasionally it is found that after three months' wear some of the bricks crumble into dust; but this is believed to arise from a faulty impregnation with the asphalte, and not to any real defect in the system.

Strength of Galvanized Iron and Steel Wire.

At the wire mills of Messrs. Witte & Kaemper, says London *Iron*, a series of tests have been made to ascertain the mechanical properties of galvanized steel and iron wire, with the following results:

	Steel.	Iron.
Diameter, inches	0.16	0.161
Tensile strength per wire, pounds	2,447	1,343
Elongation, per cent	5	15

A torsion test made showed that on a length of 11.81 inches the steel wire could be twisted four times before it broke, while the iron wire stood 18 revolutions. For the tensile tests the length of specimen was 5.96 inches. The galvanized steel wire is used for wrapping ocean telegraph cables, while the iron wire is used for surface telegraph lines. The steel used is generally made by the Bessemer process, while the iron was puddled from a mixture of Westphalian mill pig, Siegen charcoal pig and pig from the Georg-Marie Hütte, at Osnabrück. The quality of the galvanizing is tested either by dissolving the coat in hydrochloric acid or by dipping the specimen a number of times for a given time for each immersion in a solution of sulphate of copper. The wire must not show any signs of a deposit of copper. For the German telegraph service the sulphate solution is a mixture of one part of sulphate and five parts of water, and the wire must undergo five immersions of a minute each. For the steel cable wire the specifications are a tensile strength of 53 tons per square inch, an elongation of 1.5 per cent., and a bending test of wrapping the wire twice around a piece of wire having the same diameter and straightening it out without breaking it.

Paper from Sawdust and Other Refuse.

The Rutland (Vt.) *Herald* describes a newly patented process and machinery for making paper pulp from sawdust and other materials:

The manner of reducing sawdust or shavings, pieces of wood or other fibrous materials, to a perfect pulp with this machine is to press the material heavily with the rollers, which roll over it an innumerable number of times as they revolve within an enclosed cylinder, the inner surface of this cylinder forming an endless bed, on which the rollers roll, the material being continuously forced under these rollers by its circulation. The disintegration is assisted by the action of steam under pressure of 50 to 80 pounds, to which is added a small per cent of alkali, which neutralizes the acids and destroys the gum of the wood. The steam and alkali also soften and toughen the fibre so that it is not broken by the rollers. *There is no grinding in this process*, no part of the pulp is made into a powder; consequently the product is all fibre. Bark and knots sometimes accompaning sawdust can be screened out or pass off with water during the process of washing. Pulp made by this machine and process is superior in every respect to any other pulp made from wood, not excepting chemical pulp, the reason of this being that the fibre is preserved intact and the cellulose is left with it, thus making it soft and pliable and at the same time giving it great strength. The tensile strength per square inch of newspaper, which contains from 50 to 75 per cent. of ground wood pulp and balance hard stock, is from 8 to 12 pounds, while this lot of paper *made entirely of sawdust*, stood a test of 17 pounds to the square inch, thus demonstrating that it is much stronger than paper made from one-third rags. While the paper possesses such great strength, it will be seen from this newspaper that the stock is not harsh and takes a fine impression. We have been informed by experts in paper manufacture that there is no doubt but that this sawdust pulp will take the place of rags for "hard stock."

All kinds of paper can be made from this pulp without the addition of such expensive material as rags, cotton, jute, etc., thus enabling paper to be manufactured at a reduction of from 30 to 50 per cent. of the present cost of manufacturing. The pulp from this machine and process is adapted to the manufacture of different grades of paper, from wrapping to the very finest grades of white. The unbleached pulp will make wrapping paper equal in color and strength to the best manilla.

After this machine was successfully completed, it was found that there was no known process for bleaching this wood pulp economically and satisfactorily on a commercial scale. Several months have been consumed by Mr. Pond in perfecting a bleaching process which is entirely new. It will bleach wood pulp, jute, flax, hemp or any other fibrous material perfectly white in l rge quantities in a very expeditious, efficient and economical manner, without the slightest injury to the most delicate fibres.

The woods adapted to this process of making pulp are the soft woods, spruce, pine, fir, hemlock, poplar, in fact all woods not classed as hard. Hemlock makes the strongest fibre of them all, it being fully equal to jute in strength, spruce, pine and poplar coming next.

Aside from the manufacturer of paper, this pulp, owing to its unusual strength and toughness is perfectly adapted to the manufacture of pails, barrels, mouldings and many articles of commerce for which wood is now used. Although already these articles have been made from the ordinary ground wood pulp, yet owing to lack of fibre they do dot possess the strength which such articles should have. But this pulp being all fibre gives the strength which has heretofore been lacking.

The Saw Dust Pulp and Paper Company, of Rutland, Vt., recently incorporated by the State Legislature are now ready to treat with parties for territory or license to manufacture and operate machines or for the purchase of machines under their patents.

Preserving Railway Sleepers.

At the Technical Convention of the German Railway Union, last July, a report on preserved sleepers was presented, which was supplementary to a previous report published some years ago. Of the railways answering the circular of inquiry sent out by the committee, 34 used preserved sleepers now, against 24 in 1868. The number of railways using each of the methods of preservation in 1865, 1868, 1878 and 1884 was:

	1865.	1868.	1878.	1884.
Sulphate of copper	15	6	5	1
Sulphate of iron and zinc	1	..	..	..
Sulphate of barium and oxydul of iron	2	..	..	..
Corrosive sublimate	3	6	8	4
Chloride of zinc	8	7	20	22
Creosote	4	5	13	11
Chloride of zinc and creosote mixed	..	..	4	7
Vapor of creosote (Parndis's patent)	..	..	..	1
Vapor of Creosote and creosote (Blythe's system)	..	..	1	1
Antiseptic under pressure	..	..	..	1

Thus sulphate of copper, which was the prevailing method used in 1865, is now used by but one railway, but the use of chloride of zinc has extended until it prevails, and alone or in combination with creosote is used by 29 out of 48 railways which use any preservative. Creosote alone, however, is still, extensively used, though less so than in 1878.

THE WASHINGTON MONUMENT.—Col. Casey says, there yet remains two years work to finish the monument. So far it has cost $1,130,000. With what is underground, the obelisk is 592 ft. high and the weight is 80,378 tons. The underpining, to extend the old foundation was done under a weight of 32,176 tons. This foundation was deepened 12 ft. 4 in. and extended in all directions 23 ft. 3 in. Only one accident has happened, a workman broke his arm. The plan for the base has not yet been decided upon, but will probably include a series of grand terraces to be ornamented with statuary.

SELECTED MISCELLANY.

A PAPER chimney 50 feet high has been put up at Breslau. Compressed paper pulp is very hard to burn, and is recommended for fire-proof doors.

THERE are now 23 steel works, having among them 80 converters, in the German Empire; Austria and Hungary have 12 steel works, with 34 converters; Belgium, 3 steel works, with 18 converters; France, 7 steel works, with 34 converters; England, 23 steel works, with 115 converters, and Russia, 5 steel works, with 10 converters.

THE French Admiralty are now having thirty vessels constructed in the Government dock yards, and fifteen in private yards. Fourteen of them are ironclads and are estimated to cost $26,000,000. The two principal ships, the Admiral Baudin and the Formidable, are to cost $2,000,000.

THE largest room in the world, under one roof and unbroken by pillars, is at St. Petersburg. It is 620 feet long by 150 in breadth. By daylight it is used for military displays, and a battalion can completely manenver in it. Twenty thousand wax tapers are required to light it. The roof of this structure is a single arch of iron, and it exhibits a remarkable engineering skill in the architect.

A NEW stone saw consists of three square wires of steel, twisted together in a slender endless cord, running swiftly over two pulleys after the manner of a band saw. In this case, however, the wire cord runs horizontally and, being moistened by a water drip, the oblique cutting edges work rapidly into the stone. This is said to be a great improvement over the old reciprocating blade, supplied with sand and water and slowly grinding its way into the stone.

A NUMBER of rifles to which a "thumb trigger" has been attached are to b· issued to various infantry battalions of the British army for experimental purposes. Great advantages are claimed for this mode of discharging. It is said that, in the hands of men who have been trained to their use, much better target practice can be made with these rifles than with those discharged by the pull of the forefinger. A trigger similar to the above was tried in the Italian army some few years ago.

THE power of modern guns is illustrated by experiments made in Italy, October 1, 1884. An Armstrong 100 ton breech-loading gun, having a calibre of 17 inches was fired, with charges of 772 pounds of powder and forged steel projectiles weighing 1,841 pounds, against targets distant about 100 yards, one of which was solid steel plate 19 inches thick backed by 20 inches of teak. The other targets varied only in material. Each target was perforated at the first round, the projectile passing through with a considerable surplus of power.

SEVERAL uses have been discovered recently for luminous paint. Engineers, by applying it to their field tapes, are able to execute their work in the very face of the enemy without discovery. The German War Office authorities have experimented with the paint for purposes of night attack, and Lieutenant Deppe, of the Belgian School of Gunnery, is investigating its merits in the same direction. The English Government is using painted framed glasses, or Aladdin's lamps, as they are called, for internal boiler inspections. Gen. Lord Wolseley took with him a luminous compass for the Nile expedition. It has also been applied in some establishments to the fire buckets, which are thus easily found in the dark.

THE old moss which forms beds of more than a foot in thickness is found in prodigious masses at various places in Norway and Sweden. Although half decomposed, it constitutes an excellent material for the manufacture of paper, specimens of which have already been offered for sale. Card-board has been made from it, some leaves of whigh are about ¾ inch thick. It is described as being as hard as wood, and can be very easily dyed and polished. It is likely that this product can be substituted for wood with great advantage in many cases, for it possesses all of its good qualities and has none of its defects. It neither splits nor warps; it can therefore be employed in the manufacture of doors and windows, cornices and many ornaments. Under the hydraulic press it can receive a consistency and a power of resistance far superior to those of strawboard.

THE *Pall Mall Gazette* reaches these conclusions as to torpedo-boats. 1. Actual experiment has proved that on an ordinary night these boats can approach unperceived to within a thousand yards of the ship attacked, though the most powerful electric lights be kept bearing on their line of approach. 2. From the time the torpedo-boats are first seen till they can discharge their Whitehead torpedoes with absolute certainty of hitting is on an average of about 26 seconds. 3. During this 26 seconds the guns of the attacked ship fire at random as owing to the darkness the sights cannot be effectively used, and the distance alters 100 yards every six seconds. 4. A foreign experiment has proved that on the torpedo hitting it makes a hole about 70 square feet in the bottom of such a powerful ironclad as the Hercules. 5. The most powerful pumps mounted in any ironclad will only keep out the water which comes in through an 18 inch hole in the bottom of the ship. Yet with all that we have fewer boats than France.

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TABLE OF CONTENTS

	PAGE
The Iquique Railroad, Southern Peru	301
Table of Sizes of Chimneys	302
Artesian Well at Bourn, Lincolnshire	302
Underground Telegraph Wires	303
Good Bricks and Brick Work	304
Building an Ice-house	304
French Population Statistics	304
Terode Boring	304
Building Stone of Colorado	304
Strength of Galvanized Iron and Steel Wire	305
Paper from Sawdust and Other Refuse	305
Preserving Railway Sleepers	305
Selected Miscellany	305
Editorial Notes	306
The Galveston Harbor Jetty	306
Personal	307
The Washington Monument	308
The Use of Double Floats in Measuring Current Velocities	308
Engineer Club of Philadelphia	308
St. Louis Engineer Club	306
Cincinnati Notes	306
The Antwerp International Exhibttion of 1885	309
Correspondence	306
Report upon the Drainage of Brooklyn, N. Y.	310
Water	311
News of the Week	311
Contracts	312

GEN. E. L. MOLINEUX, of this city, suggests a rather novel method of supplying Lord Wolseley's Soudan Expedition with water, in a short cut across the great bend of the Nile, from Korosko to Abou Hammed, 230 miles over an arid desert.

Taking as the basis of his calculations, the pipe lines of the National Transit Co., now conveying oil from Western Pennsylvania to the seaboard, he proposes that a similar line of 4 inch pipe be laid by an army, with stations every thirty or forty miles, and a pumping plant at the initial point to force the 36,000 gallons per diem. required by the present force of men and animals. The difference of elevation between the extreme points is 800 ft. and the intervening country is broken by irregular hills from 500 to 700 ft high.

The scheme is ingenious and as a problem in hydraulic engineering is not an impossible one. But we fear that the Penna. oil line, with its intermediate pumping stations to overcome the summits, is hardly a safe guide for the Soudan project. No provision is made for the secondary stations, and if there was the necessary fuel to run them would probably cost more camel power for transport than it would to carry the water at once. The grade line would probably be a very undulating one, and under a head of nearly 1500 ft. including pipe friction, we fear the pipe laying would present some difficulties, ordinary troops being employed for this service.

But the suggestion is a good one, nevertheless, and as a military expedient in a waterless country might be very successfully applied elsewhere. The protection of the line from tampering on the part of the natives would present some difficulties, as soon as they discovered that they could obtain the valuable fluid by simply breaking the pipe; but Gen. Molineux provides for this by subsidizing the desert tribes and giving them water at the regular stations.

THE suppressed report of Maj. Walter McFarland, U. S. Engineer, on the proposed Nicaragua Canal, proves among other things, the utterly unreliable data upon which the estimates of cost for this work are based. Maj. McFarland puts the figures at $140,000,000 and gives very clear reasons for doing so, but even there he bases his estimate for labor upon "Northern workmen" at $1.00 per diem, a sum entirely too small to tempt men into risking their lives in a semi-tropical swamp.

If our government is in earnest in this Nicaragua matter, the first step taken should be in the direction of an intelligent, comprehensive survey and exploration of the ground; and let it send civil engineering experts and not naval expeditions to do the work. The expedition of Capt. Selfridge, at a very considerable outlay of government funds, and a formidable array of naval officers, who knew very much less about a transit than about a rope's end, only verified the work done by *one* practical civil engineer, John C. Trautwine, assisted by one Irishman and a few Indians. The navy has had its outing across the lines of the Nicaragua Canal, several times, and as a result we as yet know nothing about it; estimates vary from $60,000,000 to $140,000,000, and no one can yet intelligently declare that the canal is practically possible at any figure.

THE New England Meteorological Society has issued its first monthly bulletin of observations. This society was formed in Boston in June of this year, and has for its purpose the promotion of uniformity and accuracy among meteorological observers, systematic observations and the discussion and publications of the results obtained.

The annual fee for membership is $3, to defray the expenses of issuing the bulletin, and full directions are given, with prices, for obtaining the necessary rain gauges and instruments of observation. All correspondence relating to membership should be addressed to W. M. Davis, Secretary, Cambridge, Mass.; and for matter relating to observation, apply to Winslow Upton, Providence, R. I. The present council of the society is made up of Wm. H. Niles, Pres.. Wm. M. Davis, Secretary, Desmond Fitz Gerald, Treasurer and E. B. Weston and Winslow Upton, Directors.

The November bulletin, No. 1, contains a summary of observations from 36 stations or towns in the New England States. This record includes total precipitation of rain and melted snow, and estimated depth of snow; the temperature, with maximum and minimum range, date etc., mean pressure; means relative humidity and the name of the observer.

The Galveston Harbor Jetty.

We print in this issue a letter from Mr. W. L. Moody, a prominent citizen of Galveston, Texas, and an ardent advocate of the jetty project of Mr. Eads. Mr. Moody attacks some of the statements made in our late illustrated article on the Government work at Galveston; as we gathered our data from the published reports of the Chief of Engineers and published them as of engineering, rather than local importance, we will answer from the same sources of information, supplementing with such other data as is obtainable.

Mr. Moody has studied the reports of the Chief of Engineers zealously, but we fear without the technical knowledge necessary for a proper understanding of all the details; otherwise he certainly would not have made the statements contained in his letter. The burden of his criticism is upon the location of the jetties, claiming that the change we illustrated was made without authority and resulted directly from the suggestions in the plan of Mr. Eads.

Mr. Moody refers to the diagram shown by Major Howell in his report of 1874 to the Chief of Engineers, defining the lines of the north and south jetties and the distance between them, as located by Major Howell, adopted by his successor and approved by the Board of U. S. Engineers. He also says that the chart published by us—"is the first one that would indicate that the Government Engineers have considered that their previous location of the jetties was erroneous and that a less width than 12,000 ft. is necessary; and further that this change was made after Capt. Eads had demonstrated before the Committees of Congress that a change was one of the things absolutely necessary in order to secure deep water."

We would respectfully refer Mr. Moody to a much later report of the Chief of Engineers than the one he quotes, that is, for 1880, part II, page 1,229. The Board of Engineers, under date of June 7, 1880 there say: "From the direction taken by the Cylinder Channel it would appear that the direction of the north jetty for a distance of two miles from the shore need not be changed. The south jetty should incline more to the north, taking a line indicated by line A. B. (on chart) so as to contract the opening between the two at their outer ends. Neither, however, should be carried more than two miles seaward until the other has progressed nearly in equal ratio, and the effects produced by their prolongations, noted from time to time, will determine the final directions the outer portions should take."

It thus appears that the location of the south jetty was modified by the Board of Engineers in 1880, at the time of commencing the work under the charge of Col. Mansfield, the present Engineer officer, by moving the outer end of the south jetty nearly a mile to the northward of the position laid out in the report of Major Howell. It also appears that the final directions of the outer portion of both jetties were to be determined by the observations on the effects produced from time to time during the progress of the work.

Referring to a report upon the Eads' bill made to the Chief of Engineers, by Col. Mansfield, March 18, 1884 and laid before the Commerce Committee of the Senate, it will be seen that after a discussion therein of the tides, currents, etc., he lays down as proposed location for the north jetty as follows:—

"A knowledge of the causes and their effects in producing the changes enumerated above,

enables us to give to the north jetty such a form and location as will utilize to the fullest extent the forces essential to the accomplishment of deep water across the bar, in accordance with the plan already adopted. To this end we would give the jetty the form of a curve, concave towards the channel, whose radius is 23,000 ft. The tangent of this curve, at its river end, should coincide with the 12 ft. contour on the north side of Bolivar channel, and its inner end should be abreast the 27 ft. depth in that channel. The outer end should extend to the 20 ft. contour. This would give it a length of 14,340 ft., and, on the basis of the cost of the south jetty, can be built 12 ft. high for the sum of $700,000. By commencing at the outer end, and constructing that portion upon the shoalest part of the bar first, we would accomplish results which would at once increase the available navigable depth across the bar."

Mr. Eads was in Europe at this time and had not as yet appeared in the Galveston Harbor project. In a published letter, dated Fifth Avenue Hotel, London, England, March 17, 1884, addressed to Messrs. Reagan and Maxey, Mr. Eads says:—"I must beg leave to decline to appear before the Congressional Committee as requested." Mr. Eads however did appear before the House Committee on Rivers and Harbors, on May 22, 1884, and is reported to have made an exhaustive presentation of his views in the matter.

It thus appears that the final location of both jetties was made by the government engineers before the plans of Mr. Eads were presented to Congress; in fact, the Board of Engineers contemplated a change as long ago as 1880, to bring the jetties nearer together at the outer ends, as is evidenced by the report quoted.

In reference to the depth of water to be obtained, Mr. Moody says, that all the official reports of the U. S. Engineers show that the jetties were planned with a view of obtaining only 18 ft.; and he cannot see how "works which were designed to create 18 ft. will result in securing a depth of 25 ft."

We would again refer the gentleman to the report of the Chief of Engineers for 1880, part II. page 1214, in which the adopted project and the work now under construction were discussed. We quote as follows: "An hydraulic mean depth of $17\frac{8}{10}$ ft. in the cross-section of the gorge, between Bolivar Point and Fort Point, gives an extreme depth of 44 ft. The conditions, however, are different in the gorge and on the bar, so that in the latter place we should not expect so great a difference between the mean and extreme depths; but since the minumum depth cannot be greater than the height of the jetty, and since the friction caused by the jetties themselves must prevent a uniformity of velocity throughout the section, hence we should look with confidence for an extreme depth of not less than 25 ft."

From this report it will be seen that Mr. Moody is in error in supposing that but 18 ft. in depth was sought to be obtained by the present plans.

Mr. Moody also claims that $577,000 was expended in an "experiment with gabionades." He should study more closely the reports of the Chief of Engineers; in the report for 1880, part II page 147, it appears that the amount expended to June 30, 1880, was really $618,431.75, but this sum represents the obtaining and maintaining of a good channel of 20 ft. over the inner bar, where there were previously but 11 ft., as well as the partial construction of the outer bar jetties.

We know nothing, and care less about the local or political influences that may be working in this project for the improvement of the harbor of Galveston. We simply gave the matter, at least some part of the attention it deserved as a great engineering enterprise. But as Mr. Moody has called upon us to substantiate our statements we trust that we may succeed in convincing him that we were not as much in error as he supposed. We will only make one concession, and that is, that the profile illustrated in our previous article, is a "progress profile," and does not represent the exact condition of the work at present, as we infer Mr. Moody believes it is intended to do.

We would add, however, that the difference between the plans now under construction and the one proposed is really rather a simple arithmetical problem, if arithmetic enters into "political economy." The question is very fairly stated in the letter of Gen. John Newton to the Secretary of War under date of March 27, 1884, and the letter of Col. S. M. Mansfield, Engineer officer in charge, to the Chief of Engineers on March 18, 1884. Gen. Newton says, that in the bill drawn in favor of Mr. James B. Eads and his associates, the proposition is made to give a channel not less than 30 ft. deep at high water for a round sum of $7,750,000 and the annual payment of $100,000 for maintenance of the channel for 10 years thereafter. The first *two feet* additional depth is to cost $2,000,000.

Now, according to the official reports and the letter of Col. Mansfield mentioned above, the Government estimates that under its present system, the entire cost of making a 25 ft. channel across the outer bar will be $1,825,813; less than the sum for a 2 ft. channel under the private corporation. The south jetty with $700,000 expended in two seasons work, has already increased the channel depth 2 ft., though little permanent improvement was to be expected from the effect produced by one-half of a work of this description. With the system completed by the construction of the north jetty, the gain in depth would certainly be greater than that claimed in a similar time by the competing project.

In short the question resolves itself into this, Shall the U. S. Government pay $7,750,000, during the next 16 years for doing what it could itself accomplish for just $7,000,000 *less* within the next two years? As engineers and economists, we must confess that we can see no counter argument against so plain a problem in finances. If the citizens of Galveston expect so much *more* from the present government expenditure in the time consumed, what must they think of a project that promises only the same improvement in channel depth for three times the money?

GLASGOW, Scotland, has a Sanitary Protection Association, with a membership of 206 persons, including Sir Wm. Collins, President, and many other prominent citizens. The purpose of the association seems to be the thorough examination by competent experts of the houses of the members and houses to be leased by members.

The incentive for this movement among the citizens is the charged inability of the sanitary authorities of the city to properly attend to their many duties, without heavier rates. They also claim that they could not command the services of the public officials to the same extent and in the same way as those of the servants of the Association.

The Association is yet an experiment, and though the majority speak of it as successful, one third of the original membership has already withdrawn.

This Sanitany Protection Association is practically an arbitrator between landlord and tenant, and, in many cases, a proviso is inserted in the lease, certified to by the engineer of the Association statingthat the house is safe, from a sanitary point of view. The membprship fee is one guinea per annum.

ENGINEERING NEWS for three months One Dollar.

PERSONAL.

W. B. LINSLEY has been appointed Superintendent of the Sioux City and Pacific Railroad Company, and Fremont, Elkhorn and Missouri Valley Railroad Company, vice MR. P. E. HALL, resigned, who will, however, continue as Superintendent of Construction of the latter railroad and of the Missouri River Bridge.

SHERMAN DAY, a pioneer of California, died last week. He was the only son of Dr. Jeremiah Day, President of Yale College for thirty years, and a grandson of Roger Sherman, one of the signers of the Declaration of Independence. MR. DAY was an accomplished Civil Engineer, and located the first railroad between San Jose and Sacramento, and graded the first wagon road over the Sierras.

A. G. MENOCAL, Civil Engineer U. S. N., and M. Am. Soc. C. E., R. E. PEARY, C. E., and Ensign W. I. CHAMBERS, U. S. N., have been ordered to proceed to Nicaragua and make a survey for the proposed canal through that Republic. The purpose of the expedition is to revise the former survey made by MR. MENOCAL, and investigate any change of route which may shorten the canal and diminish its cost.

CHARLES G. LINCOLN, Treasurer of the N. Y. L. E. & W. R. R. died in New York on Dec. 16th. MR. LINCOLN was 55 years old, and about 1869 became the confidential agent of Trenor W. Park, and with this gentleman was identified with the Panama R. R., the Pacific Mail and the Hudson River Tunnel, being Treasurer of the last. Last November he was appointed to the office he held at the time of his death.

JOHN HENRY HOBART was found frozen to death on the steps of the Union Pacific headquarters in Omaha, on the night of Dec. 19th. MR. HOBART was about 40 years of age, and had a reputation as an expert civil engineer. He assisted in the construction of the Lake Shore R. R., and after the destruction of the Ashtabula Bridge went to California, where he built the celebrated Loop Curve at the Sugar Loaf Summit on the California Southern R. R. For the last five years he had been engaged in work on the Union Pacific R. R. He was a phenomenally brilliant man, but was ruined, and finally met his death, through dissipation. He belonged to a very prominent Pennsylvania family.

JAMES B. FRANCIS will retire from his position as Chief Engineer for the "Proprietors of Locks and Canals on the Merrimack River," Lowell, Mass., on Jan. 1st. MR. FRANCIS was born in Oxfordshire, Eng., May 18, 1815, and served his apprenticeship of Civil Engineer on dock construction in Wales, under Alexander Nimmo, and on the Grand Western Canal in Devonshire and Somersetshire, under James Green, Chief Engineer. He came to America in 1833, and was first employed as assistant engineer on the Stonington R. R., under Wm. Gibbs McNeil and Geo. W. Whistler. In 1834, he went to Lowell as assistant to Mr. Whistler, and in 1837 he succeeded Mr. Whistler as Chief Engineer for the Proprietors of Locks and Canals on the Merrimack River," and, in 1845, was appointed agent for the same corporation. MR. FRANCIS was president of the American Society of Civil Engineers from Nov. 3, 1880, to Jan. 18, 1882, and is well known as an authority upon hydraulic engineering; his chief literary work, "Lowell Hydraulic Experiments," first published in 1855, being still regarded as one of the most exhaustive and reliable treatises on this subject in the English language. He has also frequently contributed to the Transactions of the Am. Soc. C. E. and other learned bodies. MR. FRANCIS will be succeeded by his son, Col. James Francis, who has been his able assistant for the past eighteen years, the elder Francis holding the dosition of consulting engineer.

The Washington Monument.

Until within a week the spire of Cologne Cathedral has held the championship among the world's lofty structures, with a score of 515 feet. But the National Washington Monument now surpasses this by 40 feet, being 550 feet high from the pavement to the platinum tip of the capping stone.

At its base this obelisk is 50 feet square and at a height of 500 feet, where the pyramidal roof begins it is 36½ feet square. Its total cost is $1,870,000. The interior at the base is 25 feet square, and at 150 feet up, the shafts of this chamber enlarges to 31½ feet square the result of thinning of the surround ng walls. The exterior facing of the monument is white marble and the interior lining is granite for about one half of its height, and then marble. Imbedded in the interior walls above the various platforms of the winding iron stairways are the memorial stones contributed by the various States and Territories and from foreign nations, societies and even individuals; those blocks exceed 150 in all.

This monument practically dates its being from Aug. 9th, 1783 when Congress resolved to erect "wherever the residence of Congress should be established" an equestrian Statue of Washington with suitable inscriptions upon its base; and in originally laying out the City of Washington the identical spot now occupied by the obelisk was set aside for the reception of this statue. This project however was not carried out, and in 1795, when it was proposed to erect a monument to the American Revolution, Washington himself selected this as the proper site. This plan, like the other failed, as did succeeding ones until 1833, when, under the auspices of The National Washington Monument Society, money was actually collected for this purpose, By 1847, $187,000 had been gathered together and on Jan. 31, 1848, Congress authorized the construction of the Monument on a site to be chosen by the President of the United States and the managers of the Society. The site so often chosen was again selected, known as "Reservation No. 3" in the city plans, and President Polk forthwith duly deeded it to the Society. The original design included an obelisk 600 feet high, surrounded at its base by a circular rotunda 100 feet in diameter, intended for the reception of statues of the nation's illustrious dead with vaults beneath for the reception of their remains.

On July 4, 1848 the corner stone was formally laid, the Hon. Robt. C. Winthrop being the orator of the day. Building was at once commenced but proceeded slowly and in 1854 the Society had spent $280,000 and aised the monument 170 feet. Congress having been petitioned for aid, a committee of the House approved of the work done and recommended an appropriation of $200,000 on Feb. 22, 1855. But this was the period of the Know Nothing Excitement, and on the very day that the appropriation was recommended, the books and papers of the Monument Society were forcibly seized by adherents of the American party and a new board illegally formed from their members. This action again delayed progress, and during their four years rule, only 4 feet was added to the height of the monument.

At length, on Feb. 22, 1859, the illegitimate board was ousted by the incorporation by Congress of a new National Washington Monument Society, for the purpose of completing the work; but the civil war soon followed, and no actual work was accomplished for many years. The Society during this time remained as custodian of the work done, and made numerous efforts to awaken the public to the extent of giving material aid to the enterprise, but finally, concluding that the masses could not be relied upon for voluntary contributions, petitioned Congress for assistance.

On Aug. 2, 1876, the National government took the matter in hand by appropriating $200,000 to be expended by a joint commission consisting of the President of the United States, the Supervising Architects of the Capital and Treasury, the Chief Engineer of the Army and the first Vice-President of the Monument Society. In April 1877, the Board of Engineers, appointed by Congress to examine the foundations, reported that they required strengthening and Congress authorized the expenditure of $30,000 for this purpose. Lt-Col. Thos. L. Casey was appointed by the President as engineer and Lt. Geo. W. Davis as assistant engineer in this and subsequent work on the monument. Col. Casey at once went to work and by an ingenious and bold system of trenching finally succeeded in putting under the existing foundation a concrete sub-foundation 13½ ft. deep and of a greater width, thus increasing the bearing area from 6,400 square feet to over 21,000 square feet. This was a delicate operation and a bold engineering feat.

The new foundation being completed in May 1880, on August 7th, the same year, President Hayes assisted in the laying of the first new stone, and before the end of the year the height was increased 26 ft. In 1881, 74 ft. were added; in 1882, another 90 ft., and by the end of 1883 the obelisk was 410 ft. high. This year work was resumed on April 29th, and on Aug. 10th, the 500 ft. point was reached at which height it was long ago determined to finish the obelisk, the 600 ft. shaft of Robert Mills having been abandoned.

The Use of Double Floats in Measuring Current Velocities.

M.H. Bazin, has Submitted to the French Society of Civil Engineers, some notes upon the use of double floats in measuring velocities in streams of large volume. He says that in the employment of double floats, one on the surface and the other at a fixed depth, two sources of error appear. the one due the depth the other to the absolute velocity; the two combined give an exagerated velocity and the results are in complete disaccord with those given by the wheel meter.

The author has compared the different experiments of Mr Ellis, on the Connecticut (1874) with meter and float; Mr. Allan Cunningham on the Ganges (1874-79) with floats; M. Harlacher, on the Elbe and Danube (1876-79) with meter; M. M. Nazzani and Zucchelli (1880-81) with meter; and Mr. Gordon, upon the Irawaddy (1882) with meter and floats.

He concludes from a comparison of these experiments that the results obtained with the wheel meter, under very different condi tions, agree in a remarkable manner, but this is not the case with the float experiments. The corrections that should be made with the latter method are very difficult to establish, and the formulæ can only be applied with extreme caution in testing great rivers; otherwise, the engineer is exposed to the danger of most grevious error.

Engineer's Club of Philadelphia.

At the meeting of Dec. 6, 32 members and 3 visitors being present, the following persons were announced as elected to membership:

Messrs. George Turner, Jr., George M. Newhall, Edw. Y. Townsend, Henry S. Drinker, F. W. Sargent, James Beatty, Jr., Richard Evans, Max B. Feldman, C. Frederick Moore, John S. Elliott, Conway B. Hunt, John R. Hoffman, John Mullen, Robt. Wetherill, Ferdinand Phillips and Theodore Bergner.

The Secretary read a communication from Mr. W. F. Wootten, announcing the death of Mr. Frederic C. Wootten, member of the Club, and offered a memorial notice for publication in our Proceedings.

President Ludlow exhibited a specimen of Roe's Surveyor's Steel Tape and Reel, for which some improvements, over ordinary tapes, are claimed.

Mr. Edw. I. H. Howell presented a description of English Centrifugal Pumps, the invention of John G. Appold, an English engineer who died in 1865. After spending a fortune in perfecting the machine, he gave to the world the result of his life's labor. In point of efficiency and construction, the author considers that the English machines far surpass those of any other nationality. They are used all over the world—pumping sewage, draining and irrigating—the largest and most noted plants being in Holland and Italy, that at Temara being capable of pumping half a millions gallons of water per minute, and claimed to be the most economical drainage plant in the world.

Mr. A. A. Stevenson presented a series of Gas Engine Indicator Cards, which, being rather a novelty, are interesting, and seem to show good results.

Prof. L. M. Haupt read a paper, illustrated by model and Photographs, on Movable Dams of the Chanoine-Pasgueau system, showing that the first of this kind in the United States were completed on the Kanawha River, West Virginia, in July, 1880, near Brownstown, and are known as Dams No. 4 and 5. The requirements of our western navigation made long passes a necessity for the success of the system, but it was found very difficult to manouvre dams of 250 feet length by the old method of the tripper bar. In 1885, the Pasgueau double stepped hurters were substitutes for part of the tripping bars of No. 5, and found so successful that they were also introduced on the entire length of the Davis I'd. Dams (1,260 ft.), and are now being put in at Dam No. 6 on the Kanawha. This simple, ingenious and effective improvement enables passes of unlimited width to be constructed, and thus renders the system of movable dams applicable to all classes of rivers. The economy, safety and direct and indirect benefits, were also fully developed.

A model, working upon continuous track, of appliances for Switching and Crossing Intersecting Lines on Cable Roads was exhibited, described and put in operation by Mr. Ramsden, son of the inventor. The operations of the grips, while apparently not complex, are hardly susceptible of a brief and clear written description.

Mr. H. W. Spangler presented, for Mr. P. A. Taylor, a sample and description of Wooden Water Pipe, laid by Stephen Girard in 1834, on Broad Mountain on the line of the Mahanoy and Shamokin R. R., Schuylkill Co., Pa. Mr. Thomas Sharp supervised the work. The pipe sections were of yellow pine, about 18 ft. long, 15 in. outside diam., and 3 in. bore. 1½ miles of the pipe were laid to convey water to the engines for hoisting loaded cars from the Mahanoy Valley. The section exhibited was taken up this year, having lain, for fifty years, 5 ft. deep in a conglomerate soil, and is wonderfully well preserved.

The Secretary exhibited, for Mr. C. A. Merriman, a series of interesting photographs of the track of the Mexican National Railway.

NAMING TOWNSHIPS.—In 1832 the Attorney-General of New York was directed by the State Legislature to find names for 400 new townships. So he took an ancient history and an old English reader and finished the task in a single night, all except about a dozen, which he filled in next morning by utilizing the Christian and surnames of all his friends and relatives. Similar proceedings account for the fact that in the United States there are thirty-two Washingtons, nineteen Londons, eighteen Buffalos, seventeen Brooklyns, seventeen Clevelands, sixteen Hartfords, thirteen Bostons, nine Romes, eight Philadelphias, six Chicagos, four Baltimores and four New Yorks.

ENGINEERING NEWS for three months One Dollar.

St Louis Engineers Club.

The St. Louis Engineers' Club met at the Mercantile Club House Dec. 17,, Prof. C. M. Woodward in the chair and Prof. J. B. Johnson, Secretary. The Executive Committee reported the following results of the ballot taken at the previous meeting for the election of officers for the ensuing year: President, Robert Moore; Vice-President, R. E. McMath; Secretary, T. D. Miller; Treasurer, M. L. Holman; Librarian, J. B. Johnson; Prof. Woodward and T. J. Whitman were elected Directors. The new President was escorted to the chair by a special committee, and thanked the club in a brief address for the honor conferred.

Prof. Woodward read a biographical sketch of the life of the late Prof. Chas. A. Smith, for twelve years Secretary of the club.

Prof. Johnson read a paper prepared by J. A. Ockerson, United States Assistant Engineer, upon the "Earlier Floods on the Mississippi River." The paper tended to disprove the theory that the removal of forests increased the magnitude of the floods, and in substantiation of this position cited numerous lakes on the Lower Mississippi, formed by cut-offs, and which once constituted the the bed of the river. The time of the formation of some of these lakes was unknown; others had been created within the last 200 years and some were of recent date. The banks of them all were about the same height as the present banks of the river all things being considered, which indicated that there had been no change in the relative height of the floods.

Prof. Johnson also gave some figures in regard to the causes of the collapse of the gasometer of the St. Louis Gas Company last week. He described the dimensions of the gasometer and the twelve iron cylinders that supported it. He said the cylinders were three feet in diameter at the base and only half an inch thick, and were made of cast iron; they were defective in construction and some of them showed old cracks. There were no guide or friction rollers in connection with the gasometer and the over or balance weights constituted an unsymmetrical load and were out of line with the columns, thus producing an uneven strain. The accident was occasioned by one side of the gasometer catching, which could have been prevented by friction rollers; one side settled ten feet more than the other. A similar occurrence took place several years ago, and an accident was prevented by forcing in more gas and causing the gasometer to ascend. The uneven pressure occasioned by the catching caused some of the columns to collapse. A heavy north wind prevailing at the time also contributed to the accident, as did also the snow which had accumulated on one side. The material used in the construction was described as being weak and the construction faulty. There was no explosion, the gas having escaped through holes knocked in the top of the gasometer by the collapse of the columns.

Cincinnati, Notes.

Sealed proposals will be received by the village of Winton Place, Hamilton Co., Ohio, at the office of E. F. Layman, Civil Engineer 49 West Third Street, Cincinnati, until 12 o'clock noon Tuesday December 30th, 1884 for the improvement of Station Avenue, Elm Street, Maple Street and Chester Avenue, in said village according to specifications on file at the office of E. F Layman. Bidders must use printed forms and the right is reserved to reject any or all bids.

The above work comprises the grading and graveling of about two and one quarter miles of streets, the amount of earth work being about 18,000 cubic yards. The work will be paid for by assessments upon abutting property. Winton Place is about four miles north of Cincinnati on the C. H. & D. R. R.

MESSRS. MILLS & KLINE, two of Cincinnati's heaviest real estate operators, have purchased a large tract of land at East Sycamore Station on the Cincinnati northern narrow gauge railroad, eleven miles north of Cincinnati and are now laying the same out for suburban residences. Streets are being graded and improved, a complete system of sewerage and drainage pipes laid and a number of houses being built. The work is in charge of E. F. Layman Civil Engineer of Cincinnati.

Considerable sickness now prevalent on the "hill tops" of Cincinnati is attributed to the lack of sewerage and drainage.

A thick strata of limestone underlies the soil at depths varying from five to fifteen feet, and the filth from the vaults and cesspools has drained along the top of this strata until, reaching points where the same "crops out" in the hill sides and ravines, has emptied itself into the various small water courses, and formed numerous breeding places for the zymotic diseases now so prevalent. Preliminary steps have been taken for the establishment of complete sewerage systems for all the hill top portion of the city.

The Antwerp International Exhibition of 1885.

This exhibition promises to become a great success. Foreign countries are taking an active interest in it. Thus we find that the Archduke Charles Louis of Austria is at the Austrian section, Mr. Rodolphe Isbary being the commissioner; and there are about 1,000 Austrian exhibitors entered already. The Argentine Republic has voted 5,000*l.* for the expenses of its section. The exhibits at Turin will be transferred almost entirely. A Syndicate of German traders at Antwerp have secured a space of 5,000 square meters for Germany. In the machinery gallery, the Société Cockerill will occupy a large space, with many large and powerful steam-engines, among others one of a pair of 4,500 indicated house-power, for the Russian iron-clad *Tschema* and many locomotives.

Among other Belgian engineers who exhibit are Fetis & Deliege, who occupy 350 square meters; the Société de Sclessin, 150 meters; Carels Brothers & Bollinckx, each 100 meters; M. Comez, with 50 meters, etc. Among the German engineers, the Brothers Stumm occupy 200 meters; and the Machinenbau Actiengesellschaft Essner Union, 100 meters. The Lords of the Committee of Council on Education have received information, through Her Majesty's Principal Secretary of State for Foreign Affairs, that Her Majesty's Consul at Antwerp has been appointed British Commissioner, and Mr. P. L. Simmonds has been appointed by the Executive Council of the Exhibition at Antwerp their Agent-General for Great Britain and Ireland. The office of the Agent-General is at 35 Queen Victoria Street, and communications from intending exhibitors should be addressed to him there.

A PAVING INSPECTOR.—He is there when the sand is thrown in. He may know sand from blue clay, but is not required to. He may know the paver, but he has nothing to say to him. When the blocks come he may pick up one now and then, turn it over and over to see whether it be walnut or cedar, and then lay it down with a trembling sigh, but that's all. When the blocks are all laid he remains to see the hot tar poured on and the gravel spread out. He knows hot tar from mineral paint, and he knows gravel from clover-seed, but his knowledge is thrown away. When the street is opened for traffic he certifies to that effect, and his tremendous mental and physical labors are concluded—except to draw his pay. —Detroit *Free Press.*

CORRESPONDENCE.

Galveston Harbor.

Special Correspondence Engineering News.

EDITOR ENGINEERING NEWS:—Your paper of November 29, 1884, contains an article entitled "The Galveston Harbor Jetty," with an accompanying chart purporting to show the lines of the proposed jetties, their condition at mean low tide and also the details of mattress construction. One unacquainted with the facts of the case is apt to be mislead by some of the statements of the article or by the chart which accompanies it. and I, therefore, as a citizen of Galveston, ask the privilege of making some remarks in relation thereto.

In the first place, the article seems to imply that the Government Engineers have only been constructing this work since July 13, 1880, whereas the fact is that work was begun in September, 1874, under Major C. W. Howell, south of Bolivar Channel, and in April, 1877, on his "pier" or jetty north of that channel. The system invented by this officer was known as the gabionade system which he employed from 1874 until November, 1879, when it was entirely abandoned, no good results in deepening the harbor entrance having been accomplished. In this experiment with gabions, appropriations amounting to $577,000 were consumed. The plans and work of Major Howell were considered and approved by several boards of the U. S. Engineers, of which Generals Tower, Wright and Newton were members, as may be seen by reference to the annual reports of the Chief of Engineers from 1874 to 1880 inclusive.

In the article which you publish appears the following statement:—"As at present designed, the tops of the jetties are not to be raised above the level of low water, but their plan and width will permit of an increased height if it is found in the future that a sufficient depth cannot otherwise be obtained." Also the following —"An examination, made in November, 1882, at an unusually low stage of the water, of the crest of the completed jetty, was very satisfactory. The brush work was entirely covered with stone and the stone well bedded, and in the older portions cemented together by an accretion of shells, sea-weed and moss. The worms had done no injury to the mattresses and the general stability of the work was well proven."

If the work was so satisfactory in 1882, it has certainly greatly deteriorated since that time, for a very complete and careful sounding of the depths on the crest of the jetty made within the last few weeks indicated that the average depth over the whole length of the completed jetty at mean low tide was not less than six or seven feet, and it was conclusively shown that the mattress work had been well nigh eaten up by the teredo.

The following statement is also made in the article:—"Although sufficient time has not yet elapsed to show any very marked increase in the channel depth, commerce is already benefitted by an additional depth of from one to two feet in crossing the bar."

This statement is erroneous as the various surveys of the bar from 1875 to 1883, contained in the annual reports of the Chief of Engineers, show that the actual increase of depth, if any *due to the works*, does not exceed three inches.

I desire also to call attention to the following statement in the article:—"The north jetty, not yet started, will be probably about 6,000 feet distant from its neighbor at the seaward end, increasing to nearly 9,000 feet nearer the shore."

By reference to the annual report of the Chief of Engineers, 1874, Part 1, page 722, it will be seen that Major Howell furnished with his report a diagram showing the location of the north and south jetties, and the measurement of the distance between these jetty lines by the scale as given by Major Howell, shows that they were intended to be 12,000 feet, or about 2¼ miles apart. By reference to the report of the Chief of Engineers, 1880, Part 2, page 1,305, it will be seen by Col. Mansfield's report that he adopted the jetty lines as located by Major Howell. These locations by Major Howell and adopted by Col. Mansfield were approved by all the several Boards of the U. S. Engineers, who have considered the plans for the improvement of Galveston bar. They have also been approved by the Chief of Engineers, and no authority has been given to change the locations of the jetties. The chart published by you is the first one that would indicate that the Government Engineers have concluded that their previous location of the jetties was erroneous and that a less width than 12,000 feet is necessary.

It is significant that this change of location of the jetties should only be suggested after Capt. Eads had demonstrated before the Committees of Congress that a change was one of the things absolutely necessary in order to secure deep water.

The article states that "the plan adopted for the improvement of the entrance of Galveston Harbor contemplates a depth of 26 feet." But the official report of Major Howell and Col. Mansfield as well as those of the different Boards of Engineers, all show that the jetties were planned with a view of obtaining only a depth of 18 feet. It is difficult to perceive how works which were designed only to create 18 feet will result in securing a depth of 26 feet.

The records of the Engineer Bureau from the begin-

ning of the work show that the whole plan of the engineers has been but an experiment, first with gabions and later with mattresses, but it has proved rather a costly experiment to the Treasury as well as to those interested in an improved harbor entrance at Galveston.

It is of the utmost importance that Congress and the people should not be misled in regard to this improvement—a matter in which not only Galveston and Texas are interested, but which involves to a very great degree the prosperity of a region so vast that it can only be designated as a mighty empire.

For years the interests to be immediately effected by securing deep water at Galveston reposed confidence in and gave all the aid in their power to the Engineers of the Government, hoping and believing that their repeated assurances of early success would be realized, but after years of experiment, and an expenditure of more than a million and a half of dollars, without any good results, all confidence was lost and the entire congressional delegation of Texas unanimously authorized one of their number to move to strike out of the River and Harbor Bill of 1881 the appropriation of $250,000 to continue the present plan of works. The people of Texas now turn to Capt. Eads or to one who can give them the desired relief. They are satisfied that an engineer who, in the works in which he has been engaged, has never yet made a promise which he has not fulfilled, and who is now willing to undertake the improvement of Galveston harbor on the terms of payment only for results achieved, is the one to whom this work should be entrusted. His plans differ radically from those of the Government Engineers, and the correctness of his views cannot perhaps be better demonstrated than by the fact that those engineers have in several instances substantially acknowledged them. One of the most notable of these instances being the reduction in the width between the Galveston jetties of 6,000 feet at the sea ends and 3,000 feet shoreward, if the locations have been changed as shown in the chart published by you.

Respectfully,
W. L. MOODY.

Report upon the Drainage of Brooklyn, N. Y.

To HON. W. H. FLEEMAN,
Commissioner of City Works.

Having been selected by you as experts to investigate the drainage system of the city and to suggest means of relief for the flooded districts and sewers, we respectfully submit the following report.

Although two of our members, Mr. Worthen and the chief engineer of city works, had made a similar investigation and report in December, 1878, yet the whole subject has been again gone over with our new associate A. Fteley. Since 1878, the population of the districts have been very largely increased; more paved streets, roofs, and graded lots have increased the quantity of rainfall to be passed off by the sewers, and have reduced the time of discharge; the consequences, predicted in our report, have become facts, and the pressing necessity of relief has become apparent and widespread. The first district to which our attention was called, was that of Flushing avenue and Broadway where the streets are floodod in every heavy rainfall, and the cellars are always damp and wet. We find that Broadway and Flushing avenue are for a considerable distance, level with, or below the grade of Kent avenue, there can be no escape for the rainfall by street surface or gutters. it must all take place through sewers, and if they were provided for that purpose their grade would be so light, that they would have to be wide and extended, so that except when flooded they would become stagnant elongated cesspools.

On investigation it soon became apparent to us that in both a financial and sanitary view it would best be to raise the grade of the streets and houses—and that this necessity might be shown more visibly, it was decided that this district should be modelled, together with that drained by the Kent avenue sewer. The Flushing avenue and Broadway district has been carefully surveyed, the grades of the streets, the levels of the sills and the depth of cellar of each building, and its dimensions and character have been established, and on these data it was decided by us to recommend, that the grade of Broadway, should be raised to a grade of 17 ft. above mean high tide, or from 5 to 6 ft. in its lowest points, that this grade should be extended eastwards with but a slight rise, but that westwards the grade should descend, uniformly, to that of Kent avenue, across the valley, the fill to be level, thus raising the grade of Flushing avenue and some of the streets leading into it, as far up as Park avenue.

This recommendation has been embodied in a model, in which the streets were shown at their present grade, with the lots raised to the level proposed, and was exhibited in the Mayor's office, to his Honor and the parties interested, and seemed entirely satisfactory to all. Estimates of the cost of the whole work, were made and submitted, but in the opinion of the Corporation counsel, although the expense of regrading might be assessed on the city, that of raising the buildings could not be, and that the owners neither could be compelled or ought to be compelled to do it at their own expense.

At this time therefore this decision of the Counsel, is an inseparable objection to the undertaking of the work, but which we think so important as to suggest that some legislative action should be secured to accomplish it. This district is admirably situated for workshops and manufactories, on a level plot, near to deep water; and we are satisfied that the raising of the grades, will be such a sanitary and substantial improvement, that its cost will be more than met by the enhanced value of real estate.

The present legal power, not admitting of its accomplishment, we have sought for other remedies by the diversion of water from the sewers and water sheds connecting with this district. It has been found that about 125 acres of shed would be diverted into the new Knickerbocker sewer, and arrangements have been at once made by your Engineer for this. We have investigated also a system of shallow sewers, for the interception of rainfall in the streets merely, by the connection of the catch basins in Nostrand and Marcy avenues, and also in Park avenue and Broadway, and conducting the waters by an independent outflow into the end of the canal. Estimates of the cost were made, but it was judged too expensive to be undertaken as a mere temporary expedient, to remedy an evil which could be better done by the Greene avenue sewer proposed in 1878, and which should be soon constructed, for the relief of many other districts and sewers. We do not know that we can more distinctly set forth this necessity than in the words of that report, and have therefore annexed portions pertinent thereto to this report. But although the necessity of such a construction is set forth; we have considered it important to investigate whether there were not other lines in streets parallel or nearly so to Greene avenue which would accomplish the same end, and have come unanimously to the decision to recommend tho old route. From our own experience and consultation with experts in the matter of tunneling, we are satisfied that most of this route can be made in tunnel with very little inconvenience or disturbance of street traffic.

The line as laid out and cost estimated, is from Marcy avenue through Greene avenue, Hanson place, 4th avenue, Dean street, and Amity street to the dock, the diameter 11 feet at Marcy avenue and increasing to 15 feet at the ontlet, a storm overflow at the head of the dock, and a sewage outlet of 3 feet at the end of the pier. The districts relieved by the construction of this sewer will be readily understood from the accompanying map. It may be stated as follows:

From the Bond st. sewer	about	80	acres.
Raymond st. "	"	345	"
Grand av. "	"	200	"
Bedford av. "	"	200	"
Nostrand av. "	"	300	"
Marcy av. "	"	650	"
Total, ...		1775	acres

of which 1150 acres drainage are confluents of the Kent avenue sewer to which add 125 acres drainage diverted into the Knickerbocker sewer, or a total of 1275 acres against 2300 acres at present designed to be drained. As a relief to the Wallabout district it will reduce the street flooding and improve somewhat the condition of the cellars, but still not to such a degree, but that it will be advisable to raise grades as heretofore recommended.

Relief is called for in all the other districts through which this sewer passes, and the amount diverted will be all that will be required.

It will be seen that the sewer at Marcy avenue is calculated at 11 ft. diameter largely in excess of the requirements for the discharge of the waters of the sewer intercepted, but it is proposed that a 9 ft. sewer be extended through Greene avenue to Broadway, for the drainage and sewerage of some 600 acres, whose line of discharge to deep water would be the shortest and by the best grade through Greene avenue.

The length of sewer, from Marcy avenue to the Amity street outlet, is 13,150 ft., and the cost we estimate at $875,000, and the time of construction at from fifteen to eighteen months.

The next important relief sewer is from North Second street to Union avenue sewers. We propose to run a 60 in. sewer in North Second street from the East River to 7th street through 7th street to Hope street and through Hope street to Union avenue. This main will take from the Union avenne sewer about 150 acres, and will relieve North second street by intercepting the drainage now passing into it through the submains in the 7th street, 8th street, 9th street and 10th street, The cost of this work will be about $80,000. The line of this sewer has been changed from North 4th street, as reported in 1878, because we are unable to get an outlet at North 4th street without trouble and large expense. The sewer will be 60 in. at the outlet, and reduced to about 54 in. diameter at Hope and 9th street.

We recommend for the relief of the Bond street main, an overflow at the foot of the street into the Gowanus Canal. The overflow would be kept far above the sewage flow, and therefore there would be no nuisance created in the Canal. The cost of an ample overflow at this point would not exceed $3,500.

The total cost of the work to be done under the present law would be as follows:

General Intercepting Main.....	$875 000
North Second street.....	80,000
Bond street overflow.....	3,500
Total.....	$958,500

These estimates include the total cost for all expenses, diversion of the water from the present sewers, during construction, connection with them after, shafts and manholes, removing earth from streets, etc.

In conclusion our investigations have led us to the conclusion, that it is the wisest economy, for the city to make permanent improvements, those that are not only required for immediate necessities, but such as will be required with the development of outlying districts and the increase of population; and we repeat our confirmed opinion of the desirability of the raising of the grade of the Wallabout district, as a paying investment in sanitary improvement and enhancement of the value in real estate, in a desirable and important industrial location; and that by the construction of the Greene avenue sewer many flooded districts and streets can be relieved in a short and direct line to deep water, at the least cost, and with but little inconvenience to residents on the line or disturbance of traffic.

Respectfully submitted,
ROBT. VAN BUREN,
WM. E. WORTHEN,
A. FTELEY.

WATER.

READING, PA., is making provision for a supply of pure drinking water next year. One new reservoir is nearly completed, and other arrangements are being perfected for an abundant supply.

AMONG the recent shipments of Dean Bros. Steam Pump Works, Indianapolis, Ind., were two large steam pumps having 20 inch steam cylinders, 14 inch water cylinders and 24 inch stroke. One went to Muscatine, Iowa, the other to Cloquet, Minn. Each pump can deliver 1,600 gallons per minute.

THE "town pump" on the historic College Green, at New Haven, is puzzling the wise men of that wise town by a late freak of emitting hot water from one nozzle and pure, cold water from the other. The modern innovations of steam-heating will probably explain the mystery although the nearest pipe is half a block away.

THE Michigan Pipe Co., of Bay City Mich., December 5th, completed a contract with the village of North Muskegon, Mich., for two miles and one half of their patent wood water pipe, and twenty three hydrants. Four, six and eight inch pipe will be used. The contract calls for completion of the work by June 1st proximo, but most of the pipe is now on the ground. Mr. Walker, of Port Huron furnishes pumping machinery.

RUBBER GOODS AT NEW ORLEANS.—The New York Belting & Packing Co., have taken great pains to supply their agent at New Orleans with a generous supply of Rubber Belting, Packing, Steam Hose, Rubber Mats and Matting, Car Springs, etc., for the World Industrial Cotton Exposition. They have also prepared a beautiful illuminated circular for distribution there, which has been greatly admired.

A CHARTER was granted by the State of Penna., on Dec. 17, to the South Mountain Water Co., who propose to provide Philadelphia with the much needed pure water supply. The nominal stock is $100,000, but the promoters claim that they can command $15,000,000 to perfect the scheme. The names mentioned in connection with the new company are, W. W. Maris, of Maris & Smith, Ivan Prowhatain, of the Bankers & Merchants Telegraph Co., and N. H. Smith, all of Philadelphia, and E. B. Dorsey, of New York, and John B. Scott, of Newark, N. J

The charter grants exclusive right to the company to give the city its water supply with the restrictive provision that the municipality itself can purchase the works and franchise of the company. Mr. Prowhatain said: "The thing will come before the Councils soon; it is manifest that the city on account of legal prohibitions cannot raise the money to start a new supply itself. We propose to bring the water to Chestnut Hill, and let the city distribute it from there at a price below the present cost. It will take three years to finish the works."

THE new pumping-works at St. Paul, Minn., have been completed. The business part of the city is supplied with water from Lake Phelan, three miles distant, which lies so high that water is carried to the highest buildings in that part of the town without the aid of a pumping-station. For the bluffs, where a large portion of the residences are, pumping-works are required, and water has now been supplied to that portion of the city. The works have a capacity of 1,500,000 gallons of water a day, and will soon be doubled. Two millions of dollars have been expended, and for the first time the entire city is now supplied with water, though the lower part of the city has been so provided for ten years. Heretofore there was scarcely any fire protection in the larger part of the residence portions of the city.

THE WATER SUPPLY OF VENICE.—Those who have stayed in Venice have learned what it means to be dependent for water upon an army of men who, with barges, fetch a daily, or rather nightly, supply of liquid, rarely fit to drink, across the lagoons from a stream emptying near a place called Servola. These old travellers, and those who have yet to visit that much-visited city, will be glad to learn that the inauguration of the Venice Water-works, by which a real piped water supply is carried into the romantic city took place on June 23, last, and fully realized the expectations of all concerned in this piece of hydraulic engineering, which is internationally interesting. The contract for the works has been carried out by the Public Works Company of Italy—Messrs. Breda & Co.,—including the construction of the reservoir and filter-beds at Moranzo, on the mainland, and the laying of the pipes under the Laguna to the city of Venice, of a total length of somewhat over four miles, of a diameter of 31.5 inches, and the laying of the total length of mains in the thoroughfares and canals of about sixteen miles, of a diamter of 11.8 inches. In the course of laying these mains they were taken at eighty-five places across canals, and twice across the Grand Canal, work which involved considerable difficulties. The work also included the construction of an engine-house and reservoir at St. Andrea, the erection of a pair of 50 nominal horse-power engines, together with laying on the water to all the principal buildings and hotels in the city. The work was commenced early in January, 1881, and was consigned, to the entire satisfaction of the *concessionaires*, on June 23, 1884. The concession was orignally granted to Mr. D. C. Dalgairns, C. E., of Palermo and Penge, in 1876, upon provisional plans and studies then deposited; and the works have been carried out on the definite plans presented by him on June 23, 1877. The company to which the property now belongs is the *Société des Eaux pour les Etrangers*, of Paris, which was formed for the purpose of carrying out this scheme in January, 1879.

NEWS OF THE WEEK.

Miscellaneous.

ELECTRIC LIGHTS.—The consolidation of the electric light and motor companies of New York, excepting the Daft Co., has been effected. The new company starts with a capital of one million dollars.

"BEDLO" ISLAND.—Ex-Mayor Bedlo, of Newport, R. I., says the island in New York Harbor upon which Bartholdi's statue will stand is "Bedlo," not "Bedloe," and the ex-Mayor ought to know, for his grandfather was once its owner, and gave it its present name.

LONDON AMERICAN EXHIBITION.—The buildings for the great American Exhibition, will be remarkable. The main hall will be 905 feet by 1,378 feet, and will be the largest space ever covered by one roof. The Government building will be 565 feet by 885 feet, which will be larger than the two Paris Exposition buildings. The horticultural hall will be 174 feet by 600 feet, built almost entirely of glass.

AN OLD SURVEY.—Warren, Penn., Dec. 20.—The suit of ex-Congressman L. F. Watson against Grandin Brothers, the Bailtown Oil Company and the Pittsburg Oil and Land Company for a tract of oil land in Forrest County, tract No. 3,133, is on trial in the Forrest County Courts at Tionesta. This suit involves some valuable oil lands, estimated to be of the value of $190,000. Mr. Watson claims the tract upon a survey made in 1793.

GRAIN ELEVATOR.—The Canada Pacific Railway is erecting at Fort William, Manitoba, one of the largest grain elevators in the Dominion of the United States. Over 4,000,000 ft. of lumber will be used, and it will contain 229 bins, having a total capacity of 1,200,000 bushels. Eleven cars can be unloaded at once by the shovels that are being put in. It will be completed in February.

HELL GATE.—Gen. Newton, Chief of Engineers, sent on Dec. 12th, to the House of Representatives a communication in response to a House resolution, in which he says: "No part of the amount appropriated in the River and Harbor act of July 5, 1884, for removing the reef at Hell Gate, New York, has been used for any other purpose. I have examined all the vouchers that have been paid since the 1st of July last on account of removing obstructions in the East River and Hell Gate, and none have been charged against the appropriation of July 5th for Hell Gate except those belonging to it, namely, those which cover the expenditures for labor and material supplied to the removal of Flood Rock."

NEW YORK CONTRACTS DISMISSED.—Bids opened at the Department of Public Works No. 31 Chambers Street New York on December 5th and 9th were, on the advice of the corporation counsel, rejected, as any further issue of bonds to meet the indebtedness to be incurred, if the work were let, would be prohibited by the new constitutional amendment, adopted at the recent popular State election. The above mentioned bids were for the following items of work. Regulating and grading 113th St. from Eighth Avenue to New Avenue, setting curbstones and flagging sidewalks therein. Laying crosswalks on Sixth Avenue, from 125th to 145th Streets. Paving the following streets between the limits mentioned with granite block pavement: Ninth Avenue, from 77th to 110th Streets; 82nd Street, from Boulevard to the Riverside Drive; 102nd Street, from Lexington to Fifth Avenues; 103rd Street, from First to Second Avenue; 133rd Street from Seventh to Eighth Avenues; Madison Avenue, from 86th to 135th Streets. Sewers in the following Streets, Fourth Avenue between 54th and 55th Streets: Eighth Avenue between 105th and 114th Streets; 92nd Street between Ninth Avenue and Boulevard; Tenth Avenue between 92nd and 93rd Streets; 156th and 157th Streets between Tenth Avenue and Kingsbridge Road; Kingsbridge Road between 156th and 162nd Street; Regulating and grading 114th Street, from Fourth to Eighth Avenues, setting curbstones and flagging sidewalks therein.

Should the above work be done at any future date, it will be necessary to advertise for new bids on which the work would be contracted for.

THE HASKELL GUN was again experimented with on Dec. 17 and 18. At the forty-third round the shot weighed 152 pounds, while the total quantity of powder used was 116 pounds. The shot attained the velocity of 1,801 feet per second. The elevation was 8½ degrees and the range 65½ yards. The muzzle-energy of the shot was 3,422 foot tons. This is the most powerful shot yet fired from the gun, and much exceeds the power of any gun in the world of the same calibre.

The longest-distance target at the proving grounds was selected to test the accuracy of fire. It is 3,000 yards from the gun. The first shot was fired at an elevation of 2 degrees and 45 minutes. The shot struck in front of the target, and on the ricochet it passed through it.

The elevation was then raised 2 degrees and 55 minutes. Eight shots were fired at this elevation, all of which struck the target, and the most of them near the center. It was asserted that no other gun could have hit a target at that distance with so slight an elevation, and also that these experiments have proved not only that this kind of gun gives greater range and power than any single-charge gun, but that it is very accurate. The gun is now cracked and useless.

Contracting Miscellany.

BIDS will be received by the Department of Public Charities and Correction, No. 66 Third Avenue New York, up to Tuesday Jan. 6, 1885 for furnishing lumber, doors, sashes, hardware, iron, lime, cement and brick for a new pavilion to be erected on Hart's Island. For particulars see current number of *City Record*.

THE contract for the construction of a bridge, to be placed across Grand River, at Fulton Street in Grand Rapids, Mich., was awarded to the Mussillon Bridge Co., for $20,948. The bridge to be 540 feet long, 22 feet roadway, with two 6 foot sidewalks, composed of four spans. There were seventeen bridge companies in the competition.

SHARP PRACTICE.—Wayne County, Pa., has just had an experience that may not be without a parallel in other sections, and will be useful everywhere as an example. The commissioners advertised for bids for the construction of abutments for a bridge. Two propositions were offered; one for $765, the other $1,700. The lesser bid was rejected as too low to cover a good job. The award was made to the $1,700 bidder, and he sublet the work to the other party; they divided the boodle and the county has secured entirely valueless abutments.

PANAMA CANAL.—A powerful Anglo-Dutch company has signed a contract for cutting 15,000,000 metres of the canal on the Culebra section, at a figure under eight francs per metre, the work to be finished within two years. A large force of European laborers has been ordered for the work. The dry season has had the effect of dispelling sickness here, and work on the canal is progressing favorably.

PHILADELPHIA CITY HALL.—The annual report of Struthers & Sons, contractors for the marble work of the New Public Buildings, was submitted to the architect, John MacArthur, Jr., on Dec. 11. In the report, which is very full, the following interesting statements are made: The whole amount of marble required to fill their contract is 700,672 cubic ft., or about 58,000 tons. All this stone has been received and 559,991 cubic ft. have been used in the general structure, and 43,320 cubic ft. in the clock tower. The tower, which is now 196 ft. 4½ in. in height above the pavement, will consume the balance of 79,361 cubic ft., and the quantity has been dressed and delivered at the building ready to set in place whenever the coming season permits. This great contract, the largest of its kind ever given to a single firm, and at a lump figure, is remarkable for the manner in which it has been filled. Even after the death of the senior member of the firm the work went along without hitch or discord under the direction of Messrs. John and William Struthers, the juniors in the original contract. The first cargo of marble for the building was received from Lee, Mass., February 11, 1874, and the last on November 26, 1884. The final block required to complete the work was delivered at Broad and Market streets on December 15, and the great shops on the Walnut Street wharf on the Schuylkill were closed and the army of marble cutters discharged. The greatest amount of marble received from the quarries in any one season was 88,171 cubic ft. and 9 cubic in., and the greatest number of workmen on the pay rolls of Struthers & Sons at any one time during the progress of the work was 530. The wages of this small army amounted to $29,000 per month, or an average of between $50 and $60 per man.

Railroads, Bridges and Canals.

GRAND RAPIDS, Mich., is putting up a $20,000 bridge at Fulton St.

THE CHESAPEAKE & NASHVILLE R. R., is making a "Y" at Gallatin, Tenn., to connect with the Louisville & Nashville R. R.

DAYTON, O., is to have a $100,000 railway depot. The Cincinnati, Hamilton & Dayton Railway Company is the builder.

A ST. LOUIS BRIDGE was let Dec. 11, in Forrest Park, for $7,779, to Shup Bros. Shickle, Harrison & Howard bid $9,280.80.

FAST TRAIN.—The N. Y. and N. E. Railway Co., expect to make $75,000 net by its fast train between New York and Boston, in 1885.

A BRIDGE BLOWN DOWN.—St. Hyacinthe, P. Q., Dec. 15, 1884.—The first span of the new bridge being erected across the Yamaska River was blown down to-day.

THE HENDERSON KY. BRIDGE is nearly completed. The mason work is almost finished and two spans on the south side and one on the north are erected. About one mile of trestle is yet to be built.

THE ARIZONA MINERAL BELT R. R., is reported to have purchased 8,000 tons of steel rails to lay in the spring. The road will run from Flagstaff junction on the Atlantic & Pacific, south to Globe City; a distance of 180 miles. The grading of 95 miles is completed.

NEW PENNA. R. R., a charter was granted Dec. 17, to the State Run Railroad Company, which proposes to construct a line fifteen miles in length, passing through Lycoming, Potter and Clinton Counties. The capital stock is $100,000. The president is James B. Weed, of Binghampton, N. Y.

THE ST. JEROME AND NEW GLASGOW RAILWAY was formally opened Dec. 18. It was constructed to secure an outlet for the fine country back of New Glasgow and Terrebonne, and will prove an important factor of the Canadian Pacific Railway, with which it connects at St. Jerome.

THE OHIO RIVER AND LAKE ERIE ROAD has mortgaged its entire property to secure first mortgage bonds ro the amount of $1,500,000, issued on its line from Sharpsville, Pa., through Crawford and Erie Counties to Erie. This will be a new line in the interest of the Lake Shore and in opposition to William L. Scott and the Pennsylvania Railroad which controls the Erie and Pittsburg.

VILLARD IN GERMANY.—New York, Dec. 21.—The report in Wall Street is that Henry Villard negotiated the purchase of the Northern Pacific second mortgage bonds, which have recently been sold by the company in Berlin on so favorable terms. He is said to have great financial influence in the German capital, and to possess the confidence of leading capitalists and bankers there. If he negotiated the bonds he has been very kind and gracious, for his friends think he was very badly treated by the Northern Pacific directors.

SIOUX CITY AND PACIFIC R. R.—The contract for grading 90 miles west of Valentine Iowa, nas been completed by O'Hara Bros. and the contract for grading 50 miles more has just been let to Mr. ——Treat of——who is to have grading done by July 1885. Grading will commence at Valentine about April 15, and arrangements will be made to lay and complete 2 miles of track per day, suitable for running trains 25 miles per hour (safely.) Both bridging and grading is comparatively light the entire distance of 140 miles.

A ROAD FOR ARIZONA.—In conversation with a *Star* representative, Governor Tritle expressed the opinion that Arizonians could not expect very great prosperity until they have a railroad north and south, so that the differently favored sections can exchange products, instead of sending out of the country and paying high freights. He illustrated how the mining sections especially send all the money they get away from home to buy food and pay transportation, when it would be sent to the agricultural sections of Arizona, which could be done with railroads running in the right direction. His own copper mine, the United Verde, in the northern part of the Territory, is distant from the railroad. The mine yielded $80,000 in the year past; $700,000 of that amount was paid directly or indirectly for food and transportation outside of the Territory; $200,000 of this the railroad got, and the other half million was sent to Kansas, Missouri and California for the products of their farmers, when it should now be in the pockets of the farmers.—*Tucson* (Arizona) *Star*.

UNION PACIFIC R. R.—Bostonians take great pride in the first report of C. F. Adams, Jr., as President of the Union Pacific. They say it proves him a practical railroad man. The Boston investors report an improvement, amounting to $20,000,000 in their city owned stocks, including their investments in Bell Telephone and Atchison, Topeka & Santa Fé R. R.

PANAMA R. R.—The Directors of the Pacific Mail Steamship Company have decided to pay the company's obligation to the Panama Railroad Company, which amounts to about $800,000 and bears 7 per cent. interest. It is stated, however, that the Panama Company will insist upon maintaining the present contract, which calls for payments by the Pacific Mail Company of $20,000 a month.

LOCOMOTIVE WORKS.—There are now in the United States sixteen locomotive works not including the shops owned by railroad companies. Pennsylvania has 5 of these: New Jersey and Massachusetts, 3 each; New York, 2, and Rhode Island, New Hamphire and Maine, 1 each. These works give employment to 14,000 men, and every year add about 2,600 locomotives to the number now in use.

STEEL RAILS.—Pittsburgh papers state that large block of rails for spring and summer delivery are in negotiation on the basis of $27. Small lots. ranging from 100 to 500 tons, command $27 50. Light sections, down to sixteen pounds per square yard, sell from $30 to $38, according to weight. Railway projects are looming up, and a good deal of work will be provided for during the winter months.

DENVER, N. O. & PACIFIC R. R.—Denver, Col., Dec. 19.—Articles were filed to-day with the Secretary of State incorporating the Denver, New Orleans and Missouri Pacific Railroad Company, to run from a connection with an extension of the Missouri Pacific Railroad twenty miles North of the Southwest corner of Kansas, to a connection with the Denver and New Orleans Railroad, east of Trinidad. Jay Gould, Russell Sage, John Evans, C. W. Fisher and C. B. Kountze are named as directors for the first year.

ALLEGHENEY VALLEY, R. R.—Pittsburgh, Dec. 20. In the United States Circuit Court, Receivers Scott and Barnes of the Allegheny Valley Railroad, filed an application for instructions as to the disposition of $241,772 accumulated over the operating expenses and other payments from the earnings of the road authorized by the court. The application sets forth that none of this fund will be needed for operating the road, but that on January 1, the interest amounting to $146,000 on $4,000,000 worth of bonds bearing 7 3-10 per cent. interest by mortgage on the main line, will mature.

NEW CABLE R. R.—Thomas C. Platt, Richard A. Elmer, and Chauncey H. Crosby, of New York; John N. Knapp of Auburn, N. Y., and Almeria H. Lighthall, of San Francisco, Cal., have formed a corporation known as the New York, New Jersey and Pennsylvania Railway Cable Company. This corporation is to apply "steam for motive power to propel railway cars by means of and as regulated by the devices and appliances invented by Almeria H. Lightfall." Its capital stock is to be $5,000,000, divided into 200,000 shares of $25 each. The principal part of its business is to be done in New York.

THE WISCONSIN CENTRAL people will build a line of their own into Chicago. They have little hope that the Milwaukee & St. Paul contract will hold, and arrangements have already been made, it is said, to build a line at once to Chicago. Their line now extends from near St. Paul to Schlessingerville near Milwaukee. The proposed route of the Chicago extension will run west of the Milwaukee & St. Paul road and entrance to Chicago, it is said, can readily be secured over the tracks of the Chicago & Western Indiana. It is pretty clearly settled that the Central will not join the Northwestern traffic association, until it has gone through the usual preliminary war of rates.

STEEL RAILS IN THE UNITED STATES.—The productive capacity of the steel rail mills of the United States is about 1,600,000 tons per annum. About 600,000 tons went into new lines last year, and the amount used as renewals, new second track, and siding, is estimated as 650,000 tons, or 5.42 per cent. of the total amount of rails in track. This rate is equivalent to a renewal of the lines once in 18.4 years. At the end of 1883, a little more than half the track of the United States was iron. The consumption of rails for maintenance ran down from 10.30 per cent. in 1872, when steel rails were first used, to 5.92 per cent. in 1877; then rose again to 11.16 per cent. in 1881, and receded again to 5.42 per cent. in 1883. The production of steel rails increased from 83,391 tons in 1872 to 1,304,303 tons in 1882.

PENNA. CO.—The officers of the Pennsylvania Company have completed arrangements for the consolidation of the auditors' offices of the company. A. McElevey will be auditor of freight receipts, P. Howley will be auditor of passenger receipts, and J. Instan will be auditor of disbursements. George S. McKiernan, the auditor at present stationed at Louisville, it is said will be dropped. Mr. McElevey will rank first. There has been a marked improvement in the freight business of the company's lines during the past month.

NEW ROAD TO MINNEAPOLIS.—Madison, Wis., Dec. 19.—A mortgage was filed in the Secretary of State's office to-day by W. O. Wright, of Freeport, to the American loan and Trust Company of New York, to secure $10,000,000 forty years 6 per cent gold bonds issued by the Chicago, Freeport and St. Paul Railway Company, of which he is President, to be used on account of construction and equipment of the road. The proposed road extends from Chicago to Minneapolis, via Freeport, Dodgeville, Sparta, Durand and St. Paul, a distance of 400 miles. A 100 mile branch is also to be built from St. Paul Junction, in Green County, to Portage. President Wright asserts that the line is to be built as an independent enterprise, and will be completed from Chicago to Minneapolis within the coming year.

A NEW TENNESSEE ROAD.—The proposed road, called the Middle and East Tennessee Central, will connect near Gallatin, on the Chesapeake and Nashville, and will run thence some eight miles to Hartsville, going up Bledsoe's Creek to Stovall's Gap and thence down the Creek to Willow Grove; thence to Carthage, some seventeen miles, through a rich and very productive country. The road will cross at Carthage, thence to the mouth of Indian Creek, some twelve miles; thence across the Caney Fork and out to Cookeville, which is some thirty-three miles from Carthage; from Cookeville to Bledsoe, a distance of some thirty miles. From Bledsoe to the Cincinnati Southern, at or near Glenmary, and through Jamestown, in Fentress County, is thirty-six miles, and from there to either Caryville or Buckeye, on the Knoxville and Ohio Road, is about twenty-four miles and will be upon better grades and curves.

MEXICAN RAILWAY BUILDING.—John R. Price, one of the oldest railroad builders on the continent, has been for the past two years, engaged in building the Tampico and San Luis Potosi Railroad. This is a new Mexican road, running from Tampico, on the coast, to Aguas Callentes, 260 miles. A St. Louis *Globe-Democrat* representative asked him.

"Is the railroad business profitable in Mexico?"

"I think so. The Mexican Central main line is making money, and its business is increasing all the time. You hear a great deal, I know, about the Mexican preferring the pack-saddle and the burro to the freight car. That is very true; the small merchant there has not yet been educated up to the standard of their brethern in other countries. The people in the interior are in no respect in advance of the Indians. The Navajoes of New Mexico are more advanced than the lower class Mexicans. But my belief is that incursions will be made by railroads into this primitive simplicity, and before long everything will be changed. That's why I am pleased that Diaz is now at the head of the Government. The country is owned by large land-holders, who only cultivate a small portion of their holdings. Diaz is in favor of a property tax; that is to say, he wants to have all the land taxed instead of only a part as heretofore. If this is done, the country will have to be opened. All the wild land will have to submit to the point of the plow and the teeth of the harrow. Then, as a matter of course, business will come. The railroads will repay then the enterprise of those who have built them. Mexico can be made a large exporter of grain, and it will be. I never saw such a soil or climate as it has. Three crops a year can be raised—corn, wheat and beans. I mean by that, that you can plant your land in all three successively in the one year. The grade of Mexicans, as I said, is very low. But of late they have been growing some very fine men there. They are getting smarter every day."

"Is the country a good one, phisically, for railroad building?"

"Pretty fair; still there is room for good engineering always. Our road, for instance, in leaving Tampico encountered a raise of ground which amounted to 4,000 feet in thirty-two miles. This brought us to the first plateau. There we followed a canyon, 2,000 feet deep and twelve miles long. We have seven tunnels in that twelve miles. From that on to Aguas Callentes the work will be easy, and not expensive. We have ceased operations for the time being, but will begin again about the middle of January."